The Engineer.

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VOL. CLI.—No. 3914] LONDON: FRIDAY EVENING, JANUARY 16, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department Belvedere road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—DUMMY PLUGS for VACUUM BRAKE, Malleable Cast Iron or Forged Steel.

SCHEDULE 2.—About 1380 TONS of BRIDGE WORK.

Tenders due as follows :—

Schedule 1, to reach the Director-General, India Store Department (address as above), by 27th January, 1931.

Schedule 2, to be submitted direct to the Agent, Great India Peninsula Railway, Bombay, to arrive not later than 3 p.m. (S.T.) on the 17th March, 1931. Tenders must be in rupees and must provide for delivery f.o.r. Bombay.

Tenders for both Schedules available from the DIRECTOR-GENERAL, India Store Department, at a fee (which will not be returned) of 5s. for each Schedule. 6363

TENDERS FOR PLANT.

The Electricity Supply Board invite TENDER for the PURCHASE of PLANT in Electricity Stations as follows :—

LOT 1.
DUNGARVAN.—Gas Engine and Generator ; Gas Engine ; Oil Engine and Generator ; Gas Plants (2) ; Blower Motor ; Booster Set, Air Pump and Motor ; Water Tanks (7) ; Fuel Tank ; Switchboard.

LOT 2.
ENNISCORTHY.—Oil Engines and Generators (2) ; Booster Set ; Switchboard ; Water Cooling Tower ; Fuel Tank ; Gantry ; Auxiliary Air Compressor ; Water Circulating Pumps (2).

LOT 3.
FETHARD.—Suction Gas Engine and Dynamo ; Gas Engine and Generator ; Spare Generator ; Petrol Engine ; Gas Plants (2) ; Water Turaine ; Compressor ; Water Tanks (6) ; Switchboard.

LOT 4.
CHARLEVILLE.—Gas Engines and Generators (2) ; Gas Plants (2) ; Water Motor Pump ; Water Tanks (2) ; Booster Sets (2) ; Switchboard.

LOT 5.
RATHKEALE.—Gas Engines and Dynamos (2) ; Gas Plants (2) ; Blower Motor ; Booster Set.

LOT 6.
LISTOWEL.—Gas Engines and Generators (5) ; Gas Plants (4) ; Booster Set ; Spare Generator ; Blower Motor ; Water Pump ; Motor-driven Pump and Stand-by Pump ; Water Meter ; Water Tanks (14) ; Switchboard.

LOT 7.
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LOT 8.
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LOT 9.
KELLS.—Oil Engine and Generator ; Booster Set.

LOT 10.
SWINFORD.—Gas Engines and Dynamos (2) ; Gas Plants (2) ; Booster ; Switchboard.

LOT 11.
CARLOW.—Gas Engines and Generators (3) ; Oil Engine and Generator ; Gas Plants (2) ; Booster Set ; Blower Motor ; Motor Pumps (3) ; 4 H.P. Motor ; Oil Separator ; Switchboard.

LOT 12.
COOTEHILL.—Dynamo.

Full particulars may be obtained from

THE SECRETARY,
Electricity Supply Board,
60-62, Upper Mount-street, Dublin.

All Tenders must be received not later than Twelve Noon on 31st January, 1931.

The Board do not bind themselves to accept the highest or any other Tender 6341

City and County of Kingston-upon-Hull.
ELECTRICITY DEPARTMENT.

The Electricity Committee of the Hull Corporation invite TENDERS for the following CONTRACT, viz. :—
CONTRACT 159.—ELECTRICALLY OPERATED SLUICE VALVES, 42in. and 48in.

Tender form, general conditions and specification can be obtained upon application to the undersigned on payment of Two Pounds for each specification, which amount will be returnable on receipt of a bona fide Tender.

Additional copies may be had at a cost of One Pound each, not returnable.

Cheques and postal orders to be made payable to the City Treasurer, Guildhall, Hull.

The Corporation does not bind itself to accept the lowest or any Tender.

Tenders to be addressed to "The Chairman, Electricity Committee, Town Clerk's Office, Guildhall, Hull," and endorsed "Contract 159," and must be delivered to the above address not later than Noon, Monday, the 16th February, 1931.

J. N. WAITE, M.I.E.E., F.I.F.,
City Electrical Engineer.
Electricity Works,
Sculcoates-lane, Hull,
January, 1931. 6340

Southport and District Water Board.
JUNIOR ENGINEERING ASSISTANT.

The Water Board invite APPLICATIONS for the POSITION of JUNIOR ENGINEERING ASSISTANT.

Candidates must be qualified Engineers, good Draughtsmen and Surveyors. Previous experience in a Waterworks Undertaking is desirable.

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Forms of application may be obtained from the undersigned, to whom applications, accompanied by copies of three testimonials, must be returned not later than Noon on Friday, January 30th, 1931.

C. BURTON EDE, M. Inst. C.E.,
Engineer and Manager.
14, Portland-street, Southport,
January 12th, 1931. 6350

The Engineer

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Armstrong College,
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(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

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Fee for the Course 5s. 6323

PUBLIC NOTICES

University of London.

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PATENTS

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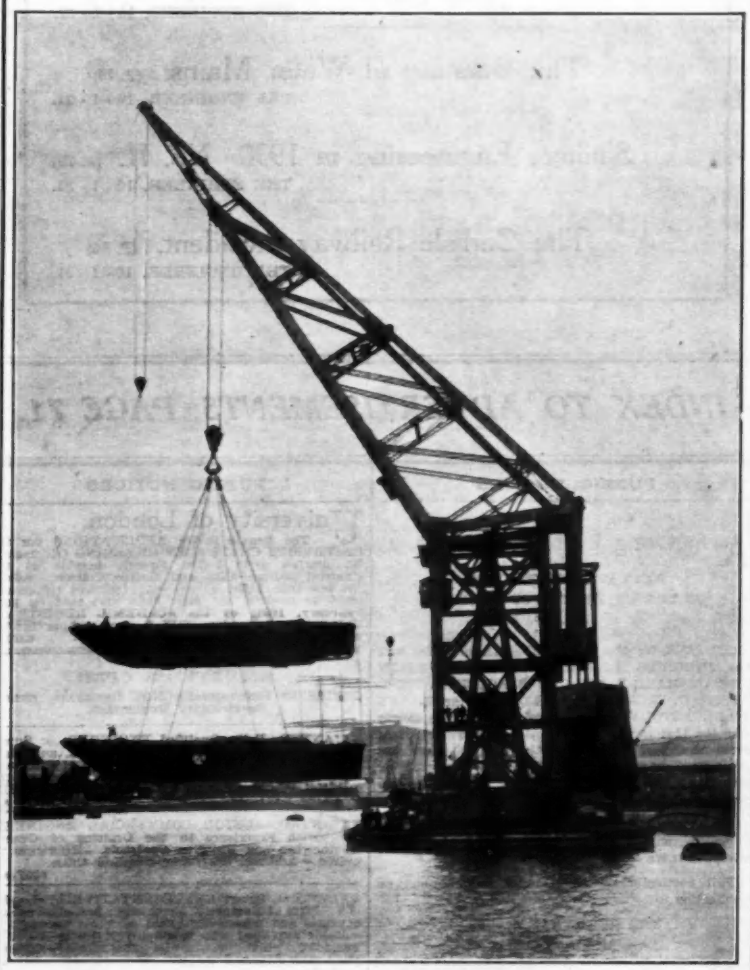

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P635 I

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HIGH-CLASS LATHE FOR DISPOSAL, S.S. and S.C. ALL-GEARED HEAD for MOTOR DRIVE. 16in. centre, 27ft. between centres, swing 2ft. over two saddles, 20 tons, not worked 40 hours; cost £2850, maker's price to-day £2000 approx.; will take reasonable offer. STEEL RACK STEEL GEARING COMPLETE.—Address, 6366, The Engineer Office. 6366 G

For continuation of For Sale Advertisements see page 72.

Spencer-Bonecourt Patent Waste Heat Boilers.
Broadway Bldgs., Broadway, Westminster, S.W. 1.

A Seven-Day Journal

A Huge Canal Scheme.

IN connection with the findings of the Royal Commission on the Co-ordination of Transport, a summary of which is printed on another page of this issue, it is interesting to note that work has been begun on improvements to the Grand Union Canal. The Royal Commission was of the opinion that no improvements could be made to waterways before amalgamations had occurred. The Grand Union Canal Company was formed as the result of the amalgamation of a number of minor concerns and now finds itself in a condition prosperous enough to warrant an expenditure of £1,000,000 on improvements. A Bill, formally authorising the actual development scheme, is awaiting the approval of Parliament, but already long stretches of the London to Birmingham Canal are being deepened by the use of new bucket dredgers which are worked by crude oil engines. These dredgers are able to operate anywhere on the system, and it is claimed that they are capable of doing three times as much work as those formerly in use. The engineers to the company have conducted a number of experiments to discover the best method by which to strengthen weak places along the canal banks, and a structure has been evolved which, it is believed, will withstand successfully the strain resulting from the great increase in the number of fast motor-driven boats using the canal. Most of this walling work is being done in the Midlands, where erosion due to the wash of fast boats has done considerable damage; but the work is not confined only to this part. The company controls a system of canals of a total length of 240 miles.

Hull City and the Humber Bridge.

MR. HERBERT S. MORRISON, Minister of Transport, laid the "foundation stone" for a new street between Paragon Station and Beverley-road, Hull, on Tuesday, January 13th. In a speech at a luncheon at the Guildhall, held subsequently to the ceremony, he said that it was very gratifying to see town improvements of that character being made and that it must not be forgotten, in the larger issues involved, that the widening of thoroughfares played an invaluable part in admitting sunshine, air and cheerfulness into quarters which had often been lacking these prime necessaries of life. Turning to the project for building a bridge across the Humber, he said that he supposed it would form one of the most striking improvements ever devised for the benefit of the city and the adjacent counties. It must be remembered in that connection, however, that the interests of navigation had to be safeguarded. He pointed out that the inconvenience caused by Hull's isolation from the south was a very old one, and that even as far back as 1872 Bills for establishing communication of some sort were promoted. Hence the recent discussions on the subject did not turn upon some new and unexpected demand, but upon a need which had been felt for some generations past. He said that he earnestly hoped that the bridge scheme, which had been drawn up by eminent engineers accustomed to problems of navigation and shipping, would be given a fair and unbiassed hearing by all parties affected, with the one aim in view of serving the welfare of the general public in Hull and the neighbouring counties. He believed that there was one aspect of the subject which would appeal to all who took a broad view of our national industries, namely, the desirability of encouraging the steel trade. The building of a great bridge over the Humber would give a much-needed fillip to trade and provide a large amount of employment.

Combined Air and Ocean Freight Service.

ARRANGEMENTS have just been completed between Imperial Airways, the Cunard Steamship Company, and the White Star Line for the institution of a new combined high-speed air and ocean freight service which is at first to extend from New York *viâ* London to India. It is hoped, in the near future, to arrange connections with the Trans-American air mail service, which will give a 12,000 miles air-ocean-air service from San Francisco to India. A parcel from the western seaboard of America will, on the institution of this through service, be flown 3000 miles across the United States to New York. There, twice a week, connections will be established with White Star and Cunard eastbound Royal mail liners, such as the "Olympic" or "Aquitania." After its 3000 miles ocean passage in one of these vessels the parcel will be transferred to an Armstrong-Siddeley air liner of Imperial Airways for its journey across Europe to Athens. Then, after crossing the Mediterranean in a large three-engined Short "Jupiter" flying boat, the parcel will be transferred again to a de Havilland "Jupiter" land plane for its final stages across the Iraq desert to Baghdad, the Persian Gulf and India. By this new air and ocean route a parcel will be conveyed from San Francisco to India in not more than fourteen days, while the time of transit from New York to India will be only eleven days. An important extension of this air-ocean freight service will be available early next year, when the Imperial Airways England-South Africa route is opened. This service will result in a very great saving in the time of transit of urgent parcels from the entire American continent, north and south, to the rapidly developing British Possessions along the East Coast of Africa. It is expected that an extensive use of the new services will be made by those consigning samples, specie, jewellery, spare parts, and urgent documents of all kinds. It is estimated that in the case of specie or bonds, the saving of interest alone, owing to the rapidity of this mode of transit, will be more than sufficient to pay the special express charges involved.

Portishead Generating Station Fire.

AN official report concerning the fire that occurred at Portishead generating station on Christmas Eve has now been received. The fire occurred in the turbo-generator room and was restricted to that room alone. The boiler-houses, transformer annexe, and the administration block were not affected. The fire is believed to have started in the following way:—A cast iron pipe conveying oil from the supply tank to the various bearings of the No. 2 turbine broke, and most of the oil in the tank was pumped on to the basement floor. An open type electric boiling ring is located in the basement in the vicinity of the break in the oil pipe. Although the evidence seems to show that the current to the ring was shut off at the time of the trouble, in the absence of any other reasonable solution, it can only be assumed that this evidence was erroneous. At any rate, the oil became ignited. Part of the roof of the building was fired, but as the roof is about 70ft. from the floor, and it is inconceivable that the flames could reach so high, it is believed that the heat was sufficient to cause some part of the woodwork to burst into flame. The fire in the roof was restricted to about one-half of the total length, but, except for innumerable cracks in the glass, a lantern in the roof was left intact. No. 2 turbine was somewhat damaged, and No. 1 turbine, which was opened up at the time of the fire for ordinary maintenance overhaul, suffered a little from material falling from the roof, but no mechanical damage appears to have been done. No. 3 turbine, a 50,000-kW set, was unaffected, and was taken into use on December 28th, as soon as the station had been cleaned up, and has been running since then continuously.

Fog Warnings at Sea.

IN an official notice which was issued to mariners on Saturday of last week, January 10th, the Trustees of the Clyde Lighthouses gave instructions with regard to the working of the new talking beacon which has been installed at the Little Cumbrae Lighthouse on the Clyde, and which in future will be in operation during foggy weather. The apparatus has been invented by Mr. Charles A. Stevenson, M. Inst. C.E., of Edinburgh, and his son, Mr. D. Alan Stevenson. It consists essentially of a radio gramophone which works in conjunction with the lighthouse fog signal. The principle of the system is that while wireless waves are carried to practically all distances simultaneously, sound takes an appreciable time to travel to the ear of the observer. The function of the stop watch is taken by the gramophone record, which counts out in speech the distance from the beacon in cables and sea miles. The exact distance of the ship from the beacon is that which the observer hears spoken on the wireless at the moment the sound at the end of the third blast of the fog signal reaches him through the air. The mariner hears through the air a repetition every 70 seconds of the fog signal, consisting of three blasts, then silence, followed by two blasts and again silence. On the wireless receiver there is repeated at 70-second intervals the name of the beacon in speech, "Cumbrae," then three blasts of the fog signal, followed by speech counting in cables and sea miles up to 5 miles; then two blasts of the fog signal and about 27 seconds of silence until the name "Cumbrae" is again spoken. The beacon transmits on a wave length of 1044 m. at a power of about 40 watts. The "Anchor" liners and coasting steamers have used the apparatus for some time past and have found that very accurate results are given. It seems likely that the system will be widely used for signally in fog at sea.

"Mechanicals"—Southern Branch.

ON Thursday, January 8th, another Branch of the Institution of Mechanical Engineers was formally inaugurated at a meeting held in the Municipal College, Portsmouth. The President of the Institution was supported on the platform by Sir George Goodwin and Sir Reginald Skelton, and Sir John Thornycroft was also present. The Lord Mayor of Portsmouth offered a cordial welcome to the representatives of the Institution. He remarked that the movement of industry to the South of England had been clearly indicated for some years, and he expressed his certainty that the presence of an organised body of engineers in the South would prove of great value to industrialists. The President replied, and thanked the Lord Mayor for his kindness in supporting the meeting by his presence. Subsequently, regretting the absence of Mr. W. H. Patchell, Chairman of the Local Branches Committee, he announced the full concurrence of the Council with the scheme. The Council felt that an area which contained over 450 members of all ranks merited direct representation on the Council, and that conveniences for local meetings were desirable. He then moved that Sir George Goodwin be elected first Chairman of the Branch. Captain White seconded that motion, which was accepted with acclamation. Sir Reginald Skelton then proposed that the Branch Committee be composed as follows:—Messrs. T. Carmichael, D. Halton Thomas, Engineer-Captain A. F. White, R.N. (Ret.), Major F. X. Miller, R.A.O.C., W. Abbott, H. Parsons, W. W. F. Pullen, H. C. Head, Major H. J. Trump, R.A.O.C., and P. Salmon. From the body of the hall the names of Captain Upton Marshall and Mr. T. Dunn were proposed. All these members were elected. The President then nominated Mr. W. Abbott as Hon. Secretary, to whose energy and enterprise the establishment of the Branch was really due. The nomination was accepted, and the meeting concluded with a vote of thanks to the President for attending in person.

The Perak River Hydro-Electric Scheme.

THE Perak River hydro-electric scheme, the engineering aspects of which were described in our issues of August 22nd and 29th and September 5th, consists of a 27,000-kW hydro-electric station at Chenderoh on the Perak River, F.M.S., and a co-operating 18,000 kW steam station at Malim Nawar. It is designed to supply energy primarily to the tin mines in the adjoining valley of the Kinta River. The steam station began work some time ago, and last July the hydro-electric station was brought into operation. The scheme has been unfortunate in so far that its completion tallied with a marked fall in the price of tin, a reduced output of the metal, and a consequent decreased demand for power. The directors of the company find that the current earnings are insufficient to meet the debenture and loan interest, and have compiled a scheme which provides for a partial moratorium as regards certain of the fixed charges. Under the Trade Facilities Act, the British Treasury guaranteed the £1,250,000 5 per cent. debenture stock, and, in addition, the Federated Malay States Government lent the company £850,000. Both these securities rank in front of the 7 per cent. participating debenture stock. In order to meet certain remaining liabilities on construction and to provide additional working capital, the directors propose to issue immediately £200,000 of 5½ per cent. prior lien stock. The scheme proposed provides that from January 1st, 1931, to August 1st, 1934, the net earnings are to be struck after providing depreciation, interest and sinking fund on the prior lien debenture stock, interest on the guaranteed debenture stock, and payments to the sinking fund. Between the dates mentioned the net earnings are to be applied first to the payment of interest and arrears on the F.M.S. Government loan, and, secondly, to the payment of interest and arrears on the 7 per cent. participating debenture stock. The British Treasury and the F.M.S. Government have approved of the scheme.

Taxation of Learned Societies.

IN *The Times* for Wednesday, January 14th, there appeared an open letter concerning the taxation of learned societies, above the signatures of Sir John Thornycroft, Sir Richard Redmayne, Mr. R. W. Dana, and Mr. L. St. L. Pendred, the President of the Institution of Mechanical Engineers. At one time the Inland Revenue authorities granted the learned societies exemption from income tax on the grounds that the work they carried on was educational, but three years ago they withdrew this privilege. This cessation of exemption occurred after the hearing of two test cases in the Courts, and the only remedy that was left to the technical institutions was to appear in turn before the Special Commissioners of Income Tax and plead their respective cases. Some have been granted exemption and some have not. Though there are minor differences in the constitutions of the various engineering societies, they all exist for the purpose of advancing knowledge, and membership confers no benefits. To obtain exemption a society must show that it has been established for "charitable purposes" only, and the words "charitable purposes" mean, according to a definition provided by Lord Macnaghten in the Pemsel appeal case: (i) the relief of poverty, (ii) the advancement of education, (iii) the advancement of religion, (iv) or other purposes beneficial to the community not falling under the preceding heads and not being merely for the purposes of sport or hospitality. It is, therefore, possible for a society to be exempted if proof can be given that it exists solely for one or more of these objects, providing that members derive no personal benefit from their membership. The Institutions of Electrical Engineers, Mining and Metallurgy, and Transport have all been exempted, having been classed in the category of "charitable only," but the Institutions of Civil Engineers, Mechanical Engineers, and Naval Architects, the Iron and Steel Institute, &c., have been denied this privilege. The position is obviously anomalous, and various societies are taking individual action. The writers of the letter make a plea that the subject should be dealt with on broader lines and state their opinions that all institutions whose work and position is recognised should be exempted from income tax.

The Automatic Manufacture of Automobile Frames.

No. I.

A CONTINUOUS daily output of 10,000 frames for "automobiles," from a plant that operates at least 90 per cent. automatically and with a force of only about 200 men, is the rather startling record of the manufacturing plant of the A. O. Smith Corporation at Milwaukee, United States of America. Steel plates entering at one end emerge in 90 minutes as completed frames, but 40 minutes of this time is spent in the cleaning, painting, and drying operations. Thus the actual manufacture from rusty plate to finished frame requires somewhat less than a minute. In this period the 100 to 125 different parts or pieces, including rivets, have to be assembled and fastened together. At intervals of 8 seconds, these finished frames are delivered by a conveyor, ready for shipment or storage. Yet each frame, with its hundred or more separate parts, requires some 500 to 600 operations.

This work goes on almost continuously, usually for two shifts per day, but in periods of heavy demand the plant has worked three shifts. There is no fixed or definite daily production, since this depends upon the orders in hand and the time demanded for delivery. But the plant has actually produced 10,000 frames per day and has attained the record of eight completed frames per minute. With such intricate and complicated mechanism, and the very close tolerances required, it is necessary to stop at times in order to inspect and adjust the machinery and to renew tools, gauges, or other parts that even begin to show signs of wear.

As far as actual capacity is concerned, that has not yet been reached, but it is considered that an output of 12,000 frames in a day could be accomplished readily. In fact, while the plant is timed for an output of eight frames per minute, it has been reported that it may be speeded up to ten frames per minute, or 600 per hour. At any rate, the present astonishing speed and capacity by no means represent the ultimate limit.

The ordinary "automobile" frame consists of six main parts, namely, two side bars and four cross bars riveted together. But there are numerous attachments in the shape of brackets and spring hangers which have to be set in place and riveted so that the total number of parts may be about 125. Further, the long side bars are not straight and parallel, but are bent horizontally, so as to be closer together at the front end, besides being bent or curved vertically to the required contour. The details vary, of course, with the style and make of car. Raw material for manufacture consists of long and narrow flat steel plates or strips for the side bars, shorter plates for the cross bars, steel stamped parts for the attachments, and rivets to hold the parts together. The stampings and rivets are made at these works.

In Figs 1 and 2 are shown the first and last stages of manufacture. The former shows the flat plates passing through the series of presses which constitute one stage of the operations, while at the lower left are piles of completed frames. In Fig. 2 is seen the storage yard, with frames stacked for shipment, being handled by a crawler crane with an L-shaped jib to give the necesssary reach over the tall stacks of frames.

A general plan, Fig. 3, shows the lay-out or arrangement of the machinery—the details of which will follow—in the main manufacturing building, which is 850ft. long and 220ft. to 360ft. wide. Plates for the frame bars enter at the top left-hand or north-west corner and go first to the automatic inspection machine, as indicated by the line of arrows. Thence they pass to the pickling and cleaning machine, beyond which the long plates go to the side bar presses, while the short plates go to a group of machines arranged in four rows in the middle of the building. From the presses the side bars go in pairs to the long assembly group at the south side of the building. Leaving this, they take a transverse course across the end of the building and across the head of the cross bar group, the side and cross bars being assembled during this movement. At the end of this travel is the nailing machine in which the rivets are inserted by compressed air, and beyond this are two parallel lines of travel through a series of automatic riveting machines.

Then the completed frames return along the north side of the building to the washing machine and the painting machine with its drying ovens, from which they are carried to the overhead storage space at the west end or out at the south-west corner to the storage yard.

The machinery of the plant as a whole is arranged for a uniform rate of production, so that as each set of plates starts at one end, at the inspection machine, a finished frame is delivered on the shipping floor at the other end of the machine lay-out. The machinery is divided into groups or units to provide flexibility, so that interruption in any one group, as by a tool jamming or breaking, the entire plant would not need to be stopped. The speed of each unit also is adjustable within a considerable range, in order to adapt it proportionately to any desired rate of production and to varying details of frame design.

These units are as follows:—(1) Picking up, inspecting, cleaning, pickling, and oiling the steel plates. (2) Presses for shaping the side bars of the frames. (3) Attaching fittings to the side bars. (4) to (7) Four parallel units, which are also parallel with the third unit, for shaping the four cross bars and applying their attachment. (8) Assembly of the side bars and cross bars into complete frames, this unit being arranged at right angles to and across the ends of units (3) to (7). (9) Inspection. (10) Washing, painting, and baking. To provide against mishaps, an electric control operated by a push-button is installed at every working position, so that an operator can stop the whole line or unit. The same pressure of the button also gives a signal calling for a repair man.

Exact and continuous accuracy is essential in such rapid mass production, since all parts must fit with very close tolerance. Consequently, not only is the raw material inspected and subjected to chemical and metallurgical and physical tests, but the product of each line or unit is inspected. Hourly samples from certain points, including final assembly and the shipping floor, are checked by the purchaser's gauges as to dimensions, fittings and tolerances. The stamped attachments or fittings are also frequently inspected and checked. To maintain this exactness there is continual frequent renewal of jigs and tools subject to wear.

Of the raw materials, the most important are the thin flat plates of high-carbon steel, which are to form the side bars and cross bars of the frame. These are made to very close specifications as to dimensions, chemical composition and physical properties in order to stand the treatment required for the manufacturing processes. Taking the long side-bar plates as an example, the first operation is automatic mechanical inspection. A long bar making rapid reciprocating strokes is equipped with magnets, and at each forward stroke it extends over a stack of plates from the steel mill, picks up a plate and carries it back.

All the plates are normally of exact dimensions as they come from the mill, and such plates the conveying bar releases and drops on to a pile or stack at the end of each return stroke. But let a plate vary even minutely from the standard or specification in regard to length, width, thickness or straightness and the automatic devices will detect it at once. Then the pick-up bar, when it reaches the end of its return stroke, does not drop the plate, but moves backward laterally and drops the plate on a pile of rejected plates behind the pile of good plates. These rejects are infrequent, but are caught unfailingly by the inspection apparatus, which can handle as many as 900 plates in an hour.

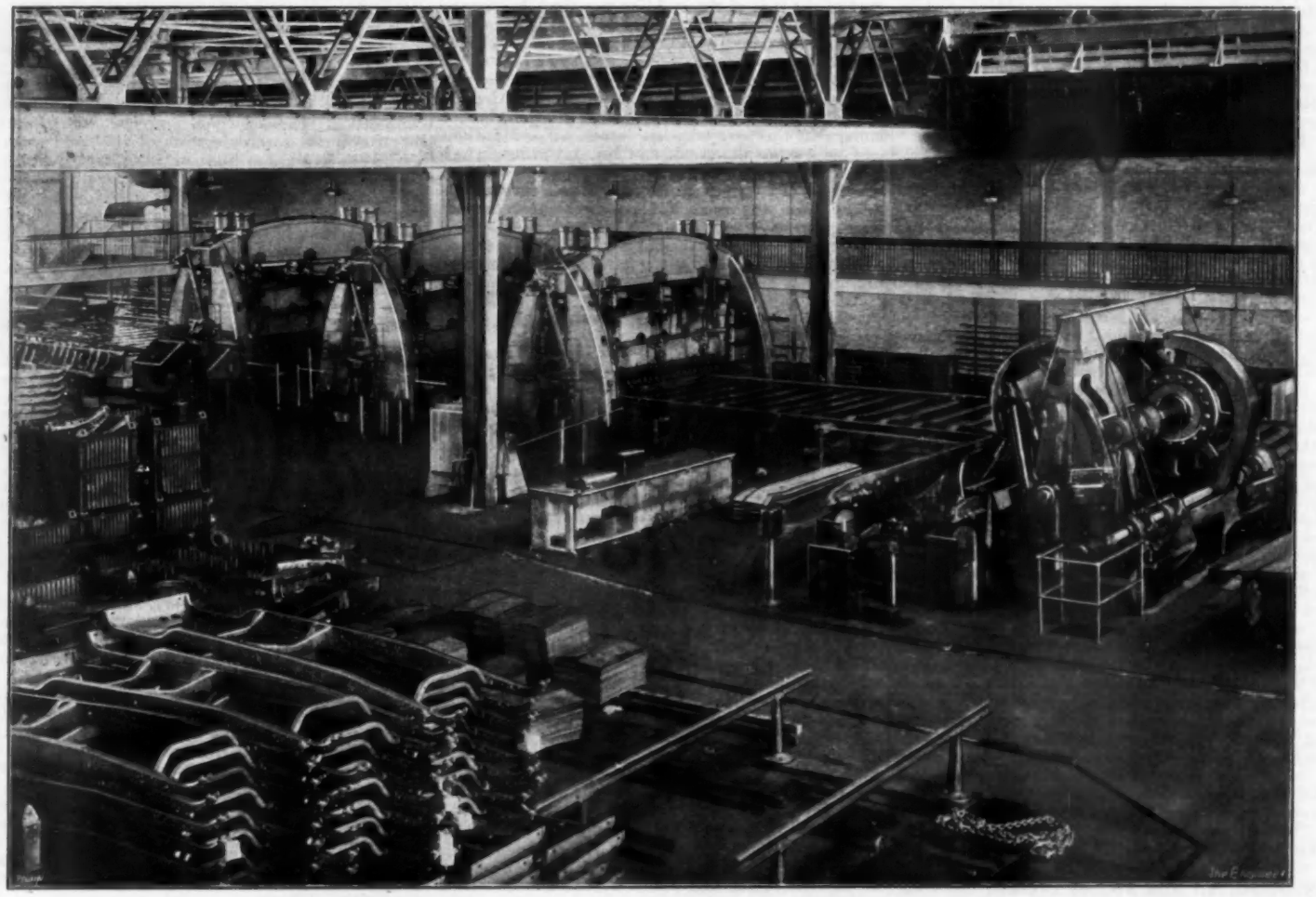


FIG. 1—FIRST STAGE OF AUTOMATIC MANUFACTURE OF AUTOMOBILE FRAMES

At intervals an overhead crane picks up a bundle of plates and delivers them to a pickling machine, where all rust, scale and dirt are removed. The plates are stacked in open crates of 5 tons capacity, which are handled through the several baths or processes by an overhead electric crane. After an acid bath the plates are washed with water and an alkaline solution, and are then dipped in an oil bath so as to pass readily through the machines. An overhead crane delivers bundles of clean and oiled plates upon the apron, or dead plate, of a conveyor, which feeds the first set of machines. Two men feed the plates to the conveyor, as this is one operation for which no satisfactory automatic apparatus has yet been devised.

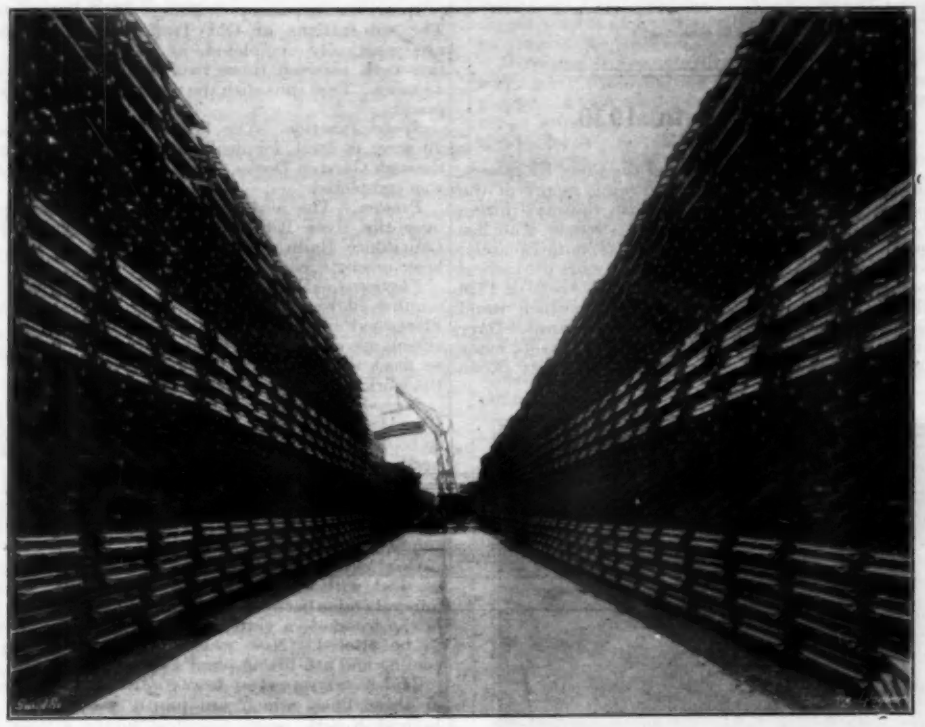


FIG. 2—STORAGE YARD FOR FRAMES

This set of machines is shown in Fig. 1. At the right is the off-setting press, which is at the side of the conveyor. Further along are two multiple punches and a blanking press, past all of which the conveyor passes. Above is an overhead electric travelling crane. As each plate moves forward, laid crosswise on the conveyor, it is picked up by a horizontal reciprocating bar fitted with magnets, and is carried endwise into the offsetting press, one stroke of which bends the flat, straight plate edgewise to the horizontal outline of the side bar of a frame. As it is ejected from the side of the machine, another reciprocating bar returns the shaped plate to the conveyor. The plates thus bent horizontally are shown in the foreground in Fig. 5, page 78.

The plate conveyor consists of a pair of parallel reciprocating bars fitted with hinged dogs and making short rapid strokes. At each forward stroke the dogs, in upstanding position, push the plate along the supporting guides. On the return stroke, the dogs drop out of engagement below the plates. The conveyor is in duplicate, each set making strokes alternately, and having a device which turns over each alternate plate so that they are in pairs, a right and left side bar for each frame. The plates pass first through a pair of multiple punches, for rights and lefts, as shown in Fig. 1, the strokes of the punches being so timed that each alternate plate passes untouched through the first machine and is punched in the second, the sets of punches in the two machines being arranged, of course, to fit the shapes of right-hand and left-hand bars respectively. A fourth, or blanking, press, at the left in Fig. 1, takes all the bars, trims their ends and shapes their contours.

Next in order are two forming or channelling presses, which convert the flat plates into trough or channel section. These presses, shown in the foreground of Fig. 5, are for rights and lefts, like the punches. Consequently, alternate plates pass the first press, are turned over by the finger device shown in the conveyor in the foreground, and then go to the second press. These presses, it will be seen, are at the side of the conveyor, like the offsetting press, and the plates enter them endwise. But, instead of being ejected at the side and returned to the conveyor, they pass on through the presses for delivery to the side bar assembly unit. These six presses are driven by one electric motor of 600 H.P., and they have a capacity for producing 900 side bars per hour. The forming process completes the first group or unit of operations. So far the bars have been handled singly. Beyond this they go in pairs, side by side, as the right and left side bars of ultimate completed frames. Except for hand feed to the conveyor all movements and operations have been effected automatically.

For the next series of operations, known as the side bar assembly, the two bars ejected simultaneously from the forming presses, are shifted inward or closer together on lateral conveyors, shown just beyond the presses in Fig. 5, and are fed to a conveyor 350ft. long, extending nearly the full length of the building. This conveyor, operated by connecting-rods from large cams, moves intermittently, making a complete stop of a few seconds duration at about 20 points in the length of its travel. It is driven by a 200 H.P. motor. These halts are for the application of various pressed-steel attachments, as for brackets and spring hangers. At the middle right in Fig. 5, under the travelling crane, are four stamping presses for the manufacture of spring hangers.

The conveyor is composed of a series of about 40 carriages, on each of which are two smaller carriages with lateral travel, or at right angles to the travel of the conveyor. On each of these side carriages is clamped a side bar. Rows of machines in duplicate are arranged along the conveyor, and men are stationed at certain points, all operations being duplicated simultaneously on the two bars of each pair.

Thus, at one point, as the conveyor stops, the carriage is held in fixed position by stops or lugs. Hinged arms swing out the smaller carriages—which, also, are held rigidly by stops, on opposite sides of the conveyor. A man puts an attachment in place and slips a rivet into the corresponding holes in bar and attachment. The carriages are released; the hinged arms pull them back on the main carriage, which also is released, and the conveyor makes another forward move. At the next stop, the arms push the carriages outward again and bring the bars into exact position in the jaws of two automatic riveting machines and hold them rigidly while the jaws close and clinch or set up the rivet.

As the riveter jaws open, the carriages and bars are again swung back on the main carriage in time for the next move of the conveyor. At each stop of the conveyor, therefore, two operations are performed at each carriage in the line. This side bar assembly conveyor, with its two rows of machines, is shown in both Figs. 4 and 5, the latter showing the receiving end and the former the delivering end, with the spring-hanger stamping machines at the left.

This group of machines has capacity for handling 450 pairs of side bars per hour. The actual number of operations on this assembly line varies with different styles of frames. A continuous slotted bed-plate along each side of the conveyor enables the riveting machines to be set in any desired position and sequence to suit different designs, an overhead electric travelling crane being provided to handle and move the

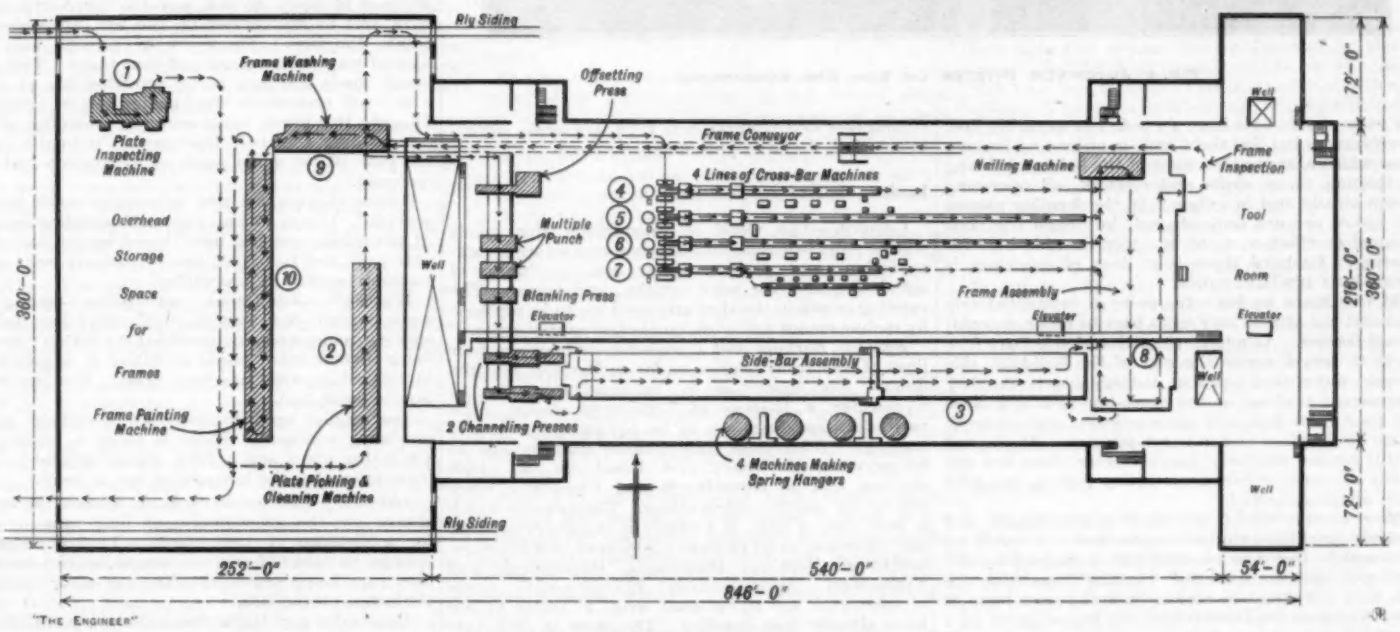


FIG. 3—GENERAL PLAN OF THE WORKS

travelling crane. As each plate moves forward, laid crosswise on the conveyor, it is picked up by a horizontal reciprocating bar fitted with magnets, and is carried endwise into the offsetting press, one stroke of which bends the flat, straight plate edgewise to the horizontal outline of the side bar of a frame. As it is ejected from the side of the machine, another reciprocating bar returns the shaped plate to the conveyor. The plates thus bent horizontally are shown in the foreground in Fig. 5, page 78.

The plate conveyor consists of a pair of parallel reciprocating bars fitted with hinged dogs and

machines. A group of these riveters is shown in Fig. 6. At the left is the rear end of one of the conveyor carriages, and upon it will be seen one of the upper carriages with a frame side bar upon it. In the rear, at the right, is one of the channelling presses.

At the end of the assembly line the conveyor carriage drops vertically, leaving the two side bars on supports, where they are inspected before being delivered to another conveyor moving at right angles to the first. The carriage dropped to the return line engages a spiral rib on a large longitudinal shaft and is thus run back to the starting point, where it is

raised vertically and takes up another set of side bars. All these movements of conveyor and riveters must be synchronised exactly to split-second timing. The bars must be run out laterally at such time and in such position that the riveter jaws will close on the bars, will hit the rivets and will then open in time to allow the bars to be run back on the conveyor carriage before it makes its next forward move. After passing through this series of operations there is a pair of complete side bars with all attachments in place.

To operate the several pairs of machines in unison there is on each side of the floor or bed-plate a long rack of heavy bars with machine-cut teeth and having a long-stroke reciprocating motion given to it by heavy cams, as this type of drive permits of very close timing. These cam-driven racks transmit the power simultaneously to all the machines in line—shears, riveters or other tools. As already explained, the machines are adjustable as to position and they may be geared to the racks at any point.

To return to the starting point, the short plates for the cross bars of the frames are inspected, cleaned and oiled in the same way as the long plates for the side bars. Then they go to four parallel, but independent, lines of machines, which are also parallel to but shorter than the side bar assembly line. As the four cross bars of a frame are all different in shape and attachments, each of the four lines produces a cross bar of particular shape, and the four bars for a frame are delivered simultaneously. Each line has a capacity of 450 bars per hour, corresponding to the 450 pairs of side bars from the side bar assembly line. In each cross bar line there are—in order—a blanking press which also punches some of the holes, a forming or shaping press, drills and riveters, all operating automatically and in unison. In the forming presses the plates are not only shaped, but have the ends crimped or offset so as to lap over the side bars for riveting. Each of these four lines of machines is driven by a 100 H.P. motor.

At this stage we have the pairs of completed side bars and the sets of four cross bars to make up completed frames. As noted, the pairs of side bars now begin to travel across the end of the building, side by side, but spaced a proper distance apart. As they pass across the end of the cross bar assembly lines the four cross bars are automatically and consecutively set in place and in exact position. At the end of this general assembly line, therefore, there are sets of the six parts or bars constituting frames, but with parts all disconnected.

Now comes one of the most extraordinary and almost incredible automatic operations. As each set of complete but disconnected bars is carried by the conveyor into the so-called "nailing" machine the side bars are thrust inward against the cross bars, in their permanent position, and the frame is set in a machine having a series of nozzles arranged to fit exactly the several rivet holes—vertical and horizontal. To each nozzle is fitted a rubber tube connected to a rivet magazine. As the frame halts momentarily, an entire set of rivets, perhaps forty or sixty in number, is shot into the holes simultaneously, thus "nailing" the frame members or bars together with loose rivets.

An overhead reciprocating carriage handles the frames for this operation, moving two frames at each stroke. At the end of each return stroke it picks up an un-nailed frame from the end of the general assembly conveyor and also the frame just nailed. On the forward stroke or travel it drops the "nailed" frame upon a conveyor and at the same time drops the other frame into position for nailing. Returning empty, it picks up this second nailed frame and also an unnailed frame from the assembly conveyor. The outgoing conveyor carrying the nailed frames is parallel with the assembly conveyor, but is in two parallel lines, the first moving in the opposite direction to the assembly conveyor and the second moving in the same direction as the latter. This conveyor is served by a series of automatic riveting machines. The nailing machine has a capacity of 450 frames per hour. Its noise is rather deafening, as some sixty steel rivets are shot into place simultaneously at intervals of only a few seconds.

(To be continued.)

FIG. 4—AUTOMATIC RIVETER ON SIDE-BAR ASSEMBLAGE

Railways in 1930.

BY the continued courtesy of the Chief Engineers, we are enabled to give the following report of the engineering activities of the British railways during the past year. The list of works is longer than has been customary for some years. That, unfortunately, is not due to the companies being in a more prosperous condition, but, first, to the agreement made in 1929 with the Government that capital works which would balance the remission of the Railway Passenger Duty would be undertaken, and, secondly, to grants made by the Government, under the Development (Loan Guarantees and Grants) Act, 1929, for works undertaken that would relieve unemployment.

London, Midland and Scottish.

Camden.—The work of remodelling this goods station so as to give additional shed and siding accommodation, and parking space and an improved circulating area for road vehicles, was begun. The existing cranes in the shed and yard are to be replaced by mobile cranes and a 50-ton electric gantry crane.

Between Barking and Upminster.—There are four lines of way from London as far as Barking, and the double line thence is to be quadrupled up to Upminster, a distance of 7 miles 65 chains. The two additional lines are to be equipped for electric traction. Additional intermediate stations are to be provided at Upney and Heathway, at which stations and at Hornchurch and Upminster there are to be electric sub-stations. Gale-street, which is now only a halt, is to have a passenger station, and there are to be extensive additions and improvements at Barking, Dagenham, Hornchurch and Upminster. Approximately 375,000 cubic yards of earthwork are to be dealt with, of which 91,000 have already been handled. The work at all points is proceeding.

Tilbury.—The new station at Tilbury has been mentioned in our annual article for the last three or four years. It was brought into use on March 31st. The passenger landing stage in the river and certain portions of the railway station were the subject of an article in THE ENGINEER of July 11th last.

Northampton.—The additions, to deal with down traffic between London and Rugby, mentioned in our article a year ago, were brought into use. They include a new down loop, 1000 yards long, five storage sidings to accommodate 433 wagons and ten sorting sidings that hold 850 wagons.

Between Stockport and Buxton.—Up and down loops, each three-quarters of a mile in length, are being provided at Hazel Grove, and up and down loops, each half-a-mile in length, at Dove Holes.

Manchester South Junction and Altrincham.—This line, which is 9 miles 49 chains in length and has 27 miles of track, extends from London-road station, Manchester, to Altrincham, where it joins the line of the Cheshire Lines Committee. It is jointly owned with the London and North-Eastern and is being converted to electric traction on the overhead system, with current at 1500 volts. Two additional stations are being provided and the occasionally used station at Old Trafford is to be a regular station, for which purpose the necessary buildings are being erected. The sub-stations at Old Trafford and Timperley are practically completed, as is the whole of the line-work between those two stations, a distance of 4¾ miles. Trial runs with the new trains are now being made.

Speke Junction.—The laying-down of sidings on 20 acres of land, for dealing with the timber traffic through Garston Docks, mentioned herein a year ago, was completed.

Preston.—The most easterly of the three bridges over the river Ribble is that built for the East Lancashire Railway—opened in 1850. It has now been reconstructed.

Fleetwood.—During the last twenty years the number of regular trawlers using the fish dock at Fleetwood has increased from 60 to 180, and the vessels are much bigger in size. Great improvements, to meet this increased traffic, are being made, and the work approaches completion.

Barrow.—The timber jetty at No. 2 berth at the Ramsden Dock has been renewed. Of the 34 bays to be dealt with in the corresponding renewal of No. 4 berth, 26 have been completed.

Paisley.—The goods loop lines between Paisley and Pollock Junction are being signalled for passenger traffic. When completed, 32 trains per hour will be run in either direction, instead of 26, as at present.

Cricklewood, Wellingborough and Toton.—In order to deal with the "Garratt" locomotives working mineral trains between Toton and London, the layout in the locomotive yards at these three stations have to be altered. New wheel drops and mechanical coaling and ash-lifting plant are being provided.

Mid-Nottinghamshire Joint Railways.—The purpose of these lines, which are jointly owned with the L. and N.E.R., were described herein a year ago. Some 920,000 cubic yards of cutting are necessary, and approximately 800,000 have been already removed. Seventeen of the 26 bridges are finished.

Beeston.—Twenty sidings are to be laid down here to deal with the L.M. and S. traffic off the above-named new railways. Ten of the new sidings have been brought into use and good progress is being made with the remainder.

Chaddesden.—Additional accommodation for a further 1032 wagons has been provided on the up side between Derby South Junction and Chaddesden South Junction. About 65,000 cubic yards of filling was required.

Ambergate.—The main line from Derby of the former Midland Railway divides, towards the North on the right and to Manchester on the left, at Ambergate South Junction. There are at present only two lines of way on the south at that point. Two additional roads are now being provided for 1½ miles, which will necessitate the opening out of Longlands Tunnel, 101 yards long, and the widening of two bridges over the river Derwent. Up to the end of the year 23,700 cubic yards of excavation had been removed.

Carlton Sidings.—A new locomotive depôt is being provided. Out of 35,300 cubic yards of filling required, 22,850 cubic yards had been tipped by the end of the year and the laying of the permanent way in the locomotive yard is proceeding.

Wakefield.—Additional marshalling sidings, to accommodate 614 wagons, with reception facilities on the up side, are being provided at Crofton Junction. Some 40,000 cubic yards of filling is required and 31,200 cubic yards has been done. The permanent way is being laid.

The engine shed facilities at Wakefield station are being enlarged. There is to be a coaling and ash-lifting plant and a 70ft. engine turntable. The foundations for the last-named are in hand.

Mirfield.—The bottle-neck at Mirfield is to disappear by the construction of four running roads for a distance of 1900 yards. Twelve additional sidings, to hold 622 wagons, served by two reception lines, are being provided. The permanent way for the latter is being laid.

Longbridge and Barnt Green Widening. This work was completed during the year. It was a widening from two to four lines of way for 2¾ miles and included the opening out at Cofton Tunnel, 440 yards long.

Between Blackwell and Abbotswood Junction.—In this length of 15¾ miles, there occurs the well-known Lickey incline, the important station of Bromsgrove and the junction, at Stoke Works, with the Worcester branch. It is thus a busy area and considerable improvements have been found necessary to deal with the dense traffic. At Blackwell, the signalling has been improved and additional accommodation provided for dealing with the banking engines used on the Lickey. The down refuge siding is to be converted into a running loop. Between Bromsgrove and Stoke Works Junction, a distance of 2 miles, the

two running lines are to be widened to four lines. The down refuge siding at Spetchley has been converted into a running loop, and the same has been done at Abbotswood Junction, which is the point where the Worcester branch again joins the main line.

Strengthening of Bridges.—No less than 132 bridges on various parts of the system are to be rebuilt or strengthened in order to carry engines with a heavier axle load. Forty-five of them have been completed and ten others are in hand.

London and North-Eastern.

King's Cross, Hornsey and Ferme Park.—The locomotive yards at King's Cross and Hornsey are being considerably enlarged and up-to-date coaling plant and coaling facilities provided. Additional sidings, to accommodate 523 more wagons, are being laid on the down side of the marshalling yard at Ferme Park. The contract for the last-named was entered into in May and the work is well advanced.

Doncaster.—The branch, 1 mile long, mentioned a year ago, was completed. It serves the Doncaster Corporation's Wheatley Estate and a new artificial silk manufactory, and necessitated the erection of a plate-girder bridge, with a skew span of 98ft. 10½in., over the Sheffield and South Yorkshire Navigation. Additional siding accommodation, to hold 311 wagons, has been given to the down empties mineral yard. That work was begun in March and is now completed.

Manchester District.—Two additional roads, for a distance of 1¼ miles, are being laid on the two lines of way between Dinting and Mottram. The work includes a diversion. A new marshalling yard is part of the scheme. The operations were begun in April, and about 10 per cent. of the work was completed. The opening out of the two Hattersley tunnels, about 100 and 266 yards respectively in length, between Mottram and Godley, nears completion. A new goods depôt is being erected at Ashburys, on the site formerly occupied by the works of the Metropolitan Railway Carriage and Wagon Company.

Frodingham.—Work was begun on the construction of a locomotive depôt, including a reinforced concrete engine shed, turntable, water tank, coal hoist, wheel drop and equipment.

Whitemoor Yard, March.—Our article, a year ago, referred to the completion of the marshalling yard on the up side, with its equipment of wagon retarders and the electrical and automatic operation of the leading points. Work was started on a yard, to be similarly operated, on the down side. It will have 40 sidings, with a total capacity for 3647 wagons.

Temple Mills and Romford.—A new up goods line is being laid down between Copper Mill Junction, near Tottenham, through Lea Bridge station, to Temple Mills North Junction, Stratford, a distance of 1 mile 22 chains. The work is about half completed. What is locally known as the Cambridge Yard, on the down side, at Temple Mills, is being extensively altered. It was formerly a flat yard, but has been converted to a gravitational hump yard. Provision for eight new sidings has been made on the up side. The line between Romford Junction and Romford Factory Junction, a distance of 2 miles 22 chains, is being converted from a two to a four-road track. About three-quarters of the work was completed. The reconstruction of Romford station is part of the work.

Additional Loops.—Arising out of a scheme for using heavier engines on the Cambridge main line of the former Great Eastern Railway, new loops are being constructed and many of the existing refuge sidings are being converted into running loops, so as to facilitate the movement of long goods trains and to enable them to be quickly shunted clear of the fast lines for more important trains to pass.

Ely.—The station at Ely was rebuilt during the year. Among the improvements were an extensive widening of the down platform and the reconstruction of the main entrance to the station and of the station buildings.

Bridge Reconstruction.—Of the large number of bridges reconstructed during the year, two may be mentioned, viz., bridge No. 1550 and bridge No. 1814. The former carries the main line over the river Cam, about 2 miles north of Cambridge. It consisted of a wrought iron main span with timber trestle approaches and has been replaced by a steel truss girder bridge of one span. The new bridge has a clear span of 108ft. 9¾in. measured square. Bridge No. 1814, between Black Bank and Manea stations, carries the railway over the waterways known respectively as the Welney Washes, the river Delph, and the Old Bedford River. The old bridge of timber and wrought iron has been replaced by one of steel throughout. There are fifteen approach spans varying from 38ft. to 42ft.; there is one plate girder span of 59ft. 6in. over the river Delph, and a truss girder span of 134ft. 9in. over the Old Bedford River.

York and Northallerton.—Three separate widenings of the main line between these points, to join up existing four lines of way, are in hand. From Skelton Bridge, which is just to the north of York, to Beningbrough, a distance of 2 miles 25 chains, there is to be an additional road on each side of the existing double line. From Alne to Pilmoor, practically 5 miles, there is to be an additional line on the down side. Contracts for the former work have been let and that for the Alne-Pilmoor will be let immediately. From Pilmoor to Thirsk is 6 miles, and 4¼ miles further north is Otterington, whence to Northallerton, 3 miles 45 chains, the line is being widened on both sides. That work includes a burrowing junction to carry a connection from the new additional up road to the Harrogate and Leeds line.

Hull.—A big development is in hand at Hull. A new inward marshalling yard is being constructed on the north side of the Priory Main Yard. It will be approached from the west by six reception lines, each holding eighty wagons. The trains, on arrival, will be hump-shunted into thirty sidings, each accommodating sixty wagons. Power-operated wagon slipper brakes and electrically-operated points are to be some of the features provided.

Hartlepool.—Accommodation for an additional 250 wagons for coal awaiting shipment is nearing completion. A new reinforced concrete water tower and a water softening plant is being constructed and will shortly be finished.

Bedlington Viaduct.—The replacement, commenced in 1929, of this excellent example of heavy timber trestle work, which was opened in 1850, by a nine-span steel plate girder bridge was completed. The new structure is carried on braced steel towers. Its total length is 664ft. and the maximum height above the river bed is 72ft.

Doubling Single Lines in Scottish Area.—Two lengths of the main line between Edinburgh and Aberdeen are at present single tracked, *i.e.*, between Inverkeilor and Usan, 4½ miles, and Montrose and Hillside, 1¾ miles. These are to be converted to double line. The work involves the widening of four viaducts, composed of steel girders on brick piers and abutments, of which the steel work for two has been erected.

Bridge Renewals.—Reference may be made to the fact that approximately forty bridges have been renewed in the Scottish area, in order to mention that three of them have been satisfactorily strengthened by electric welding.

Great Western.

Paddington.—Considerable improvements are to be made in the Paddington terminus. They include the extension of the main line platforms so as to give a minimum length of 1000ft. and a maximum of 1240ft.; the provision of a parcel depôt and the enlargement of Bishop's-road Station. Involved in this work is the re-arrangement of the lines from Subway Junction into the station. Of that particular work about one-third was completed.

Acton.—A large concentration yard, involving a capital expenditure of over £100,000, is being provided. There will be accommodation for 960 additional wagons, and it is expected that the work will be completed in about twelve months' time.

Between Didcot and Swindon.—The loop on the up side between Wantage-road and Challow is to be supplemented by a down loop. The stations at Wantage-road, Challow and Shrivenham are to have four running roads. The approach from the east to Swindon Station is to be improved. In addition to other extensive alterations, a new locomotive depôt is to be provided at Didcot. The work has just been started.

Bristol.—Over one million pounds are to be expended on capital account in the Bristol neighbourhood. In Temple Meads passenger station itself, which is jointly owned with the London, Midland and Scottish, as successors to the Midland Railway, there are to be five additional platforms, a spacious subway—connecting all platforms—for passengers, an independent one for luggage, and a new parcels office, whilst the entrances from Bath and from Exeter are to be improved. The running lines at the Exeter end of the station are to be increased to four as far as Portishead Junction, a distance of 1¾ miles. Two of the contracts for these works were entered into during the year and the works are in hand.

Going north there are to be four lines of way between South Wales Junction, at the east end of the station, and Filton, which involves quadrupling between South Wales Junction and Dr. Day's Bridge Junction, a distance of 9 chains, and, from a point just north of Stapleton-road to Filton Junction, a distance of 2¾ miles.

Westbury and Frome.—At both these stations avoiding lines are being constructed in order to give a straight run for express passenger and freight trains, and thus to eliminate the reductions in speed now necessary over the curves approaching and passing through those stations. The work has just been begun.

Taunton.—At Cogload Junction the main lines from Bristol and Westbury join, and there are two running lines thence, through Taunton, to Norton Fitzwarren, 7¼ miles, where the branches for Minehead and Barnstaple diverge. There are to be four running lines between the two junctions named, and considerably increased accommodation at Taunton. The work was commenced during the year and is well in hand.

Between Norton Fitzwarren and Exeter.—In continuation of the improvements in the Taunton neighbourhood, five of the eight stations between Norton Fitzwarren and Exeter are to have four running roads. The selected stations, reading from the north, are:—Wellington, Sampford Peverell, Tiverton Junction, Cullompton, and Stoke Cannon. Exminster Station, immediately south of Exeter, is to be similarly treated. The works are in hand.

Dawlish.—At the beginning of the year there was a breach in the sea wall near Dawlish. This wall has has been strengthened by cementation—see Severn Tunnel below—and by the provision of additional granite footings. After the satisfactory completion of an experimental length of 100 yards, a further length, making the total dealt with one of 638 yards, was undertaken.

Royal Albert Bridge.—The strengthening of the main girders of the two river spans, mentioned herein a year ago, was completed.

Truro and the Falmouth Branch.—The relining of Polperro Tunnel, Truro, 581 yards in length, was completed, as was the replacement of the Ponsanooth timber viaduct, of a total length of 650ft., by one of masonry arches and brick piers. Another timber structure on the Falmouth branch is the Carnon Viaduct, just north of Perranwell Station. It is 766ft. long, and has twelve spans, and is being similarly replaced.

Banbury.—A new hump shunting yard, with accommodation for an additional 800 to 900 wagons, is practically complete.

Lapworth and Olton.—The railway between these two points, a distance of 8¼ miles, is being widened so as to carry four instead of two lines of way. The station accommodation at those and the three intermediate stations is being extended. About one-third of the work is done.

Severn Tunnel.—Mention was made a year ago of the cement grouting in a portion of the Severn Tunnel to prevent a leakage of water through the brickwork lining. A length of half a mile was then in hand, and has since been successfully completed. As little or no water is found to penetrate, two further lengths, of 29 chains and 15 chains respectively, including the cementation of the sea wall and Sudbrook ventilating shafts, are now being similarly treated.

The magnitude of the former work may be appreciated by the fact that over 2000 holes were drilled, and approximately 3000 tons of cement used, of which the maximum quantity injected through any one hole was 105 tons.

Severn Tunnel Junction and Rogerstone.—The marshalling yards at these places are having their capacity increased by accommodation for 1529 and 400 wagons respectively, and the works are practically completed.

Newport, Mon.—The extensive improvements at Newport Station, which have been referred to in our Annual Articles for the last five or six years, are now practically finished.

Cardiff.—The main line station is being remodelled and extensively enlarged; a new line is being laid in to connect the former Taff Vale Railway with the Riverside branch; the main line is being quadrupled for a length of 1 mile from Penarth Junction, and a new carriage shed erected. The work is well in hand.

Tonteg and Treforest.—The lines between these points that used, before amalgamation with the Great Western, to belong to the Taff Vale and Barry companies, run parallel with each other. A junction has now been put in near Tonteg Junction, at the point where the Taff Vale crosses the Barry line, and the Taff Vale line, thence to Llantrissant Branch Junction, closed. The goods lines between Tonteg and Treforest have been signalled for passenger traffic and are so used in common with the existing passenger lines.

Quakers Yard.—Three viaducts have been subject to subsidence from mining operations, and the arches are being given additional support by the introduction of timber centering and strutting.

River Towy Bridge, Carmarthen.—The wrought iron main girders of the bridge carrying the Aberystwyth branch over the river Towy have been in position for sixty-seven years. A new bridge is being built, now half completed, which will be of sufficient strength to carry a double line instead of the present single track.

Docks in South Wales.—Considerable work is in hand for additions to and renewals of hoists, traversers, &c., in connection with the general adoption of the 20-ton mineral wagon, at Newport, Cardiff, and other docks in South Wales.

Southern.

Wimbledon and Sutton.—Although the date on which our last annual article appeared allowed us to say so, it is desirable, as an event of last year, to record again that the Wimbledon and Sutton Railway was opened throughout on January 5th.

Shawford and Eastleigh.—The widening on the down side between these points, a distance of 2 miles 62 chains, approaches completion.

Pokesdown.—This is a station in the Bournemouth area, which is being rebuilt on modern lines and provided with four running roads. The latter and the greater part of the station buildings were brought into use during the year, and the remaining work approaches completion.

Exeter.—Queen-street station, Exeter, is being reconstructed. The whole of the existing station is to be demolished; new buildings are to be erected at platform level and a new main block adjoining Queen-street is to be built. The work has been begun.

Hayward's Heath.—In anticipation of the new electrically-operated services between London and

Brighton and Worthing, the station at Hayward's Heath is being provided with two island platforms and four running lines. New station buildings are to be erected on the down side at the London end. The work has just been started.

Hastings.—Extensive improvements are being made here in order to provide modern and suitable station accommodation. Two new island platforms, and the necessary accommodation, were brought into use during the year. The main entrance and its buildings are making good progress, and it is hoped to complete them in time for the summer traffic.

Headcorn.—The work of providing this station with four running lines was begun. It involves the reconstruction of the up platform and the re-arrangement of the junction with the Kent and East Sussex Railway.

Folkestone Harbour Branch.—The old timber swing bridge over the harbour was replaced by a steel swing bridge in May. This work was fully described and illustrated in THE ENGINEER of December 5th last. At the same time, certain strengthening works were carried out to the viaduct on the north side of the harbour. Heavier engines will now be able to work the boat trains over the severe gradients on this branch.

Dover Priory.—The last stage in the many improvements gradually being made in the Dover neighbourhood was started. The locomotive depôt at the Priory station was closed when the new one near the Marine station was opened and on its site a new goods yard has been laid down. The last stage, now just commenced, is the rebuilding of Dover Priory station.

Barnham Junction.—The work of reconstructing this station is nearly completed. It has necessitated the provision of two new platforms, and a subway, together with station buildings on the main road.

Isle of Wight.—The many improvements in railway facilities in the Isle of Wight, which have been undertaken since the railways in the island became part of the Southern Railway, approach completion. During the year those at Ryde, St. John's-road, were finished, and there only now remain the new coal wharves at Medina, and they will soon be done.

Additional Stations in the Suburban Area.—To serve rapidly developing residential districts new stations were opened, in July, at Birkbeck, between Crystal Palace and Beckenham Junction; North Sheen, between Mortlake and Richmond, and at Whitton, between Twickenham and Feltham. A new station was opened at Hinchley Wood, between Surbiton and Claygate, in October.

Electrification.—Further changes from steam operation to electric traction were made in July. They were: From the two junctions—Hounslow Junction and Whitton Junction—of the triangle at Hounslow to Windsor; from Dartford to Gravesend Central, and from Wimbledon to West Croydon. Consequent alterations were made at eight stations on those lines. Swanscombe Halt was rebuilt on a site nearer to Gravesend, and a new halt provided at Waddon Marsh on the West Croydon line. An additional road, for freight trains, was laid in between Beddington-lane and West Croydon. Electrical sub-stations were brought into use at Ashford, Datchet and North Fleet.

A commencement was made with the conversion of the lines to Reigate, Brighton and Worthing, and on some 36 miles of the 162½ track miles to be electrified the track work was completed. The work of enlarging the sub-stations at the points affected is also in hand.

Southampton Docks.—The big scheme of the enlargement of Southampton Docks is referred to in our separate article on "Harbours and Waterways."

Metropolitan.

Wembley and Harrow.—The widening of the 2¼ miles between these points is well in hand. When completed the Metropolitan will have four lines of way throughout between Finchley-road and the point where the Rickmansworth and Uxbridge lines separate on the north side of Harrow. These will be independent of the two lines used by the L. and N.E.R. trains from Marylebone. This work and the construction of the Stanmore branch—sanctioned last Session—will necessitate the re-arrangement of Wembley Park station.

Reconstruction of Stations.—The reconstruction and lengthening of the station at Great Portland-street was completed early in the year and similar work at Euston-square makes good progress.

London Electric Railways.

Powers were given last Session for the extension of the Piccadilly Railway, northwards from Finsbury Park to Cockfosters and westwards from Hammersmith to Northfields. Both works are already in hand.

IT is announced that the Polish Cable and Copper Rolling Works, of Warsaw, will bring into operation next April a new cable factory which has been established at Ozarow, near Warsaw. The company is said to be in financial connection with the Swiss Elwerta financing company, of Glarus—the Felten and Guilleaume group—and to work under licences from the latter company, the Siemens Company and the A.E.G.

Royal Commission on Transport.

THE final report of the Royal Commission on Transport has now been published, and we print below a summary of the findings and recommendations of that body.

RAILWAYS.

In the introduction to that portion of the report which deals with railways, it is pointed out that rail transport is in no sense obsolete; it is, indeed, an indispensable form of transport, and the only form that can meet the needs of the coal trade and those of the heavy industries in general, and it is clear that an efficient railway system is a national necessity.

The report goes on to detail certain disadvantages under which the railways are at present labouring. The British railways were the pioneers in the great revolution of transport that occurred during the last century. As a consequence, certain mistakes were made, which other countries, profiting by their experience, were able to avoid. Not the least of these disadvantages is the heavy burden of capital expenditure for constructional work which the railways have to bear.

The railways suffered severely during the war, not alone from loss of *personnel*, but also from the drain of stock—locomotives, rolling stock, rails, and sleepers—sent overseas. During the period of the war they were run at full capacity with the minimum of attention. At the close of hostilities reorganisation and overhaul was a necessity, and part of the problem by which they were confronted was made up of their claims on the Government arising out of the period of control during the war. Most of these problems were dealt with by the Railways Act of 1921, by which the present four groups were established.

It has been suggested that these amalgamations have not produced the anticipated economies. The Commission is of the opinion that the grouping is of too recent a date for it to give any considered opinion as to its effect on the companies. The opinion is expressed, however, that, although the grouping has removed competition over the greater part of the country, there is considerable room for improvement where there is competition in the services to certain towns, *e.g.*, Exeter, Birmingham, Sheffield, Leeds. It is recommended that the traffic to such places should be pooled, as thereby a better and more regular service could be maintained and considerable economies be effected; the pooling should be applicable to both goods and passenger traffic.

The present difficulties of the railways, it is declared, are due largely to the prevailing industrial depression and to a certain extent to road competition. The Commission is of the opinion that they are not doing all that they might to meet road competition. It is pointed out, for instance, that railway travel is no more rapid now than it was half a century ago, and doubts are expressed as to the wisdom of the railway companies in buying up road concerns. A warning is included that any attempt to starve the road companies would lead to bitter resentment. The Commission believes that capital would be better expended on the electrification of suburban lines. In this connection, the experience of the Southern Railway is cited. The Commission, however, refrained from taking evidence on the point in consideration of the fact that a Departmental Commission is now engaged in an examination of the subject.

With reference to the closing of branch lines, the Commission approves the scheme in the interests of economy, but suggests that the Area Traffic Commissioners should be informed beforehand in order that additional road services may be organised. It is interesting to note, in this connection, the reply of the companies that when a branch line is closed the railways themselves provide an adequate road service.

While fully realising that the provision of larger wagons than those now in use does not affect the railways alone, the Commission considers that all railways should make a real endeavour to meet the needs of such trades as the iron and steel industries in this respect. Surprise is also expressed that containers are not more generally used.

As regards railway rates, the Commission believes that on the whole little improvement could be effected.

In conclusion, it is urged that the aim should be to harmonise and co-ordinate the newer and older forms of transport, thus reaping the maximum advantage from each.

HIGHWAYS.

At the conclusion of the war and owing largely to the great increase in the number of mechanically-propelled vehicles on the roads, coupled with the restricted maintenance of highways during the war period, it was obvious that energetic measures must be taken to improve the roads. At the end of the year 1918 a large sum of money was set aside for this purpose; in 1919 a Ministry of Transport was set up; and in the following year the Roads Act was passed. Among many clauses this Act provided for a Road Fund. Grants from the Road Fund are made towards the maintenance of roads and bridges at the rate of 60 per cent. for Class I. roads, 50 per cent. for Class II. roads, and 25 per cent. for unclassified roads. In addition, large amounts are devoted to the construction of new roads.

The following figures illustrate the growth and activities of the Road Fund:—

Year.	Total receipts. £	Total net payments. £
1921	9,432,302	5,179,375
1923	12,802,754	13,466,777
1925	16,150,554	15,234,225
1927	18,232,948	24,613,320*
1930	22,124,127	20,523,884

* Includes £7,000,000 transferred to Exchequer.

In its report the Commission observes that the Roads Act has been of very great benefit, not only by reason of the improvements to the highways, which have been effected, but also because there was created by it a central department of government with a national outlook. This it regards as essential if improvements are to be made. It is pointed out that only a body with the widest views could have produced such a scheme as the Trunk Road Programme, which is still in process of being carried out. But the Commission has come to the conclusion that once this programme is completed, any scheme which would involve any large additional expenditure on the provision of more arterial roads, could not have its support. Instead, it recommends that the activities of the Ministry of Transport shall be concentrated on the following points:—

(i) The reconstruction of many existing roads.
(ii) The widening of many existing roads.
(iii) The construction of by-pass roads.
(iv) The improvement of road junctions.
(v) The strengthening of bridges.
(vi) Freeing the roads of tolls.
(vii) The progressive reconstruction of built-up areas.

The Commission adds a plea that while improvements are being brought about æsthetic requirements shall not be forgotten.

As far as improvements to existing roads are concerned, it is pointed out that it costs less to maintain a road built with full knowledge of the traffic requirements than it does when the road has been built on insufficient foundations.

Although it considers that no more arterial roads will be required in the near future, the Commission approves strongly of the construction of by-pass roads, which ease the flow of the traffic past and through a town without necessitating "improvements" or a road widening in the streets themselves.

Many pages of the Report are devoted to the subject of bridges. Although some progress is being made in the strengthening of weak bridges, principally those vested in highway authorities, at the rate of 300 or 400 a year, this rate of progress is considered to be not fast enough, and the Commission considers that special sums should be set apart from the Road Fund for the purpose of speeding up the programme. With regard to bridges owned privately, the Commission asserts that all such bridges, where they are essentially parts of the highway, should be vested in the highway authority; it recommends a method by which the transfer should be completed.

Level crossings and toll roads and bridges should be abolished. There are still upwards of eighty-eight toll bridges and fifty-five toll roads in the country, and although buying up toll roads and bridges is very expensive, the Commission is of the opinion that no difficulty should be allowed to stand in the way of their removal.

In the case of large cities in which traffic congestion is becoming very serious the Commission recommends really energetic measures, and suggests the need for some central authority to co-ordinate the requirements of the lesser authorities concerned.

A large part of the Report is devoted to motor taxation. The Commission has come to the conclusion that the ratepayers are bearing too great a proportion in respect of road costs, and that, unless relief is given, the improvements to highways will be much retarded. It is satisfied that, as a class, the users of mechanical transport on the roads are not paying too much, but it recommends that the use of vehicles not more than 4 tons in weight unladen should be encouraged by increasing the rate of taxation according to the excess in weight above 4 tons. It recommends also that no heavy motor shall be allowed to exceed 10 tons in weight unladen or the weight on any wheel exceed 4 tons. Pneumatic tires should be fitted wherever practicable, and steel tires should be abolished except for road rollers and agricultural vehicles.

Believing that it will be to the interest of the road haulage industry and the organisation of that industry in general, it is recommended that road hauliers other than those carrying for one employer only should be placed under a system of licence administered by the Area Traffic Commissioners.

The Commission regards tramways as being in a state of obsolescence, suggests that no additional lines should be constructed, and recommends that they should gradually be allowed to give way to other forms of transport. It is observed that the obligations towards road maintenance from which tramway undertakings seek relief appear to throw a heavy burden on the operators. On the other hand, the licence duty on a tramcar amounts only to 15s., in comparison with that of £96 for a fifty-six to sixty-four

seater vehicle on pneumatic tires. Hence the Commission is not prepared to recommend relief.

CANALS.

Most of the canals were built and became prosperous concerns before the advent of the railways; owing to competition with the latter their prosperity disappeared. The Report considers in some detail the reason for the failure of the canal companies to meet this competition, and goes on to consider the activities of Canal Commissioners. In its own report the Commission declares itself to be of the opinion that the canals are not obsolete and that certain navigations possess considerable value as a means of transport. Amalgamation, however, must come about before any programme of development can be put in hand. One of the chief obstacles in the way of voluntary amalgamations appears to be the unwillingness of the railway companies owning canals to amalgamate with independent canal companies. The Commission believes that it would be no hardship if, when such canals were essential to form a through route, the railways should be heard only as to price. Amalgamation is regarded as so necessary that it is recommended that the Minister of Transport should set up public trusts to acquire such canals as it is deemed desirable, in the national interest, to preserve and improve.

HARBOURS, DOCKS, AND COASTWISE SHIPPING.

With minor exceptions the harbours of Great Britain are in the hands of (*a*) local commissions or trusts not working for profit; (*b*) municipal authorities; (*c*) railway companies; (*d*) harbour companies.

The efficiency of many of these trusts and companies is undeniably high, but a number of the smaller undertakings have fallen into a state of decay owing to economic factors.

The Commission is of the opinion that in principle it is undesirable that one form of transport should own docks and harbours to which access is essential by other means of transport; and further, that the best authority to own such docks and harbours is a public trust. On the other hand, the character of the majority of railway-owned docks is such that no advantage would be gained by a transference of ownership. Some of these are no more than stepping-stones from railway to steamboat, and many of the remainder are used exclusively for the shipment of coal brought by the railways themselves. The only two ports railway owned doing general business are Southampton and Hull, and the Commission believes that the wonderful development of the former is largely due to the enterprise of the railway company concerned.

With regard to coastwise shipping, the Commission has found that there has been a considerable decline, and in view of the importance of this form of transport, puts forward the recommendation that the ports most used by the coastwise shipping, many of which have fallen into decay, should be improved. This recommendation is made as a principle, but in view of the proposals of the Port Facilities Committee, now under consideration by the Government, is not presented in detail.

CO-ORDINATION OF TRANSPORT.

With regard to the co-ordination of transport, the Commission finds itself unable to make any definite recommendations. The difficulties in the way of any such undertaking are so great. However, it suggests that in the meantime until some definite plan is agreed upon, much may be done by forming a permanent Advisory Council on Transport, limited to a small number of members. This Council would study transport problems and advise the Minister of Transport as to what action could be taken from time to time towards co-ordination.

The nationalisation of the railways was urged by several witnesses before the Commission, but it was considered that nationalisation of the railways alone certainly would not produce any real co-ordination of transport.

Four different methods of co-ordination suggested themselves to the Commission, viz.—(i.) nationalisation; (ii.) rationalisation; (iii.) a combination of both the above; and (iv.) the formation of a public trust.

Unfortunately, the Commission found that it would be impossible to discuss nationalisation without raising political differences of a party character upon which agreement would be impossible.

Rationalisation would imply the merging of all forms of transport into one huge combine, but here, again, political considerations interfere, and in any case a large amount of Government control would be required.

If a public trust was formed the body would not work for a profit, and would be entirely divorced from political action. Whether coastwise shipping could be brought into such a trust is doubtful, owing to the existence of special difficulties.

The Commission feels unable to recommend any one of these four methods of unification, not only because the changes necessary are of such magnitude, but because the members themselves could come to no agreement on the point.

RESERVATIONS.

Several "reservations" by separate members of the Commission are printed.

Sir William G. Lobjoit, O.B.E., is unable to concur in the recommendation for the licensing of road hauliers. He believes that licensing is unnecessary for the purpose in view. In conjunction with Major H. E. Crawfurd, A.F.C., Sir William Lobjoit is unable to agree to the conclusions of the Commission with regard to the partial capitalisation of the Road Fund.

Major Crawfurd submits a memorandum on the Progressive Reconstruction of Built-up Areas, dealing more fully with the subject than it is dealt with in the report.

Sir Robert Donald, G.B.E., Mr. F. W. Galton, and Mr. William Leach add a memorandum on the Co-ordination and Unification of Transport. After a study of the problem in all its bearings, they recommend a real policy of rationalisation and the creation of a National Transport Trust, to which should be delegated by the State the duty of managing the unified undertakings, and that from now onwards the policy of the State should be directed towards that objective.

Letters to the Editor.

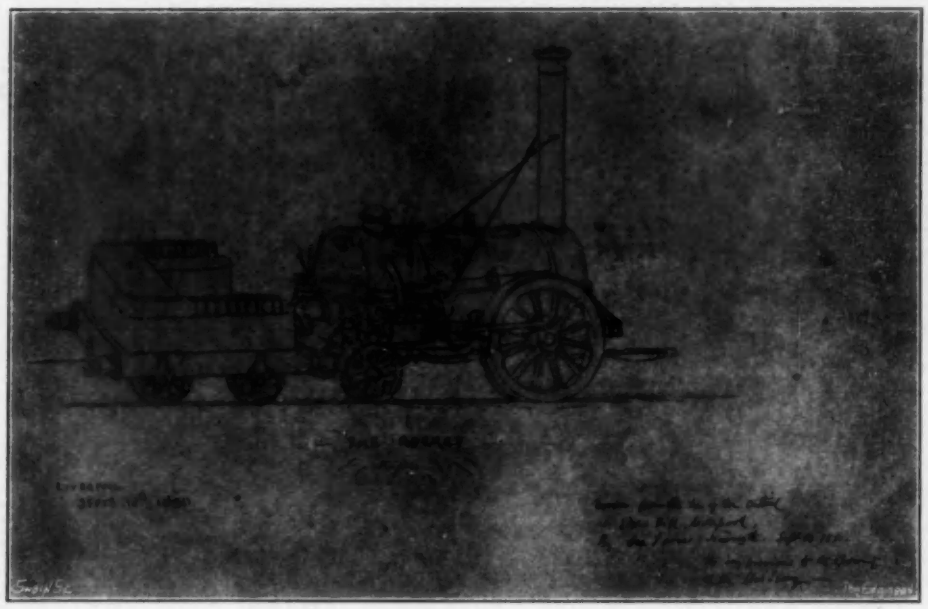
(We do not hold ourselves responsible for the opinions of our correspondents.)

THE "ROCKET."

SIR,—My reasons for ignoring the story about a second "Rocket" in my history were precisely the same as Mr. Warren's. And if it were merely a case of old men writing about something that had happened in their youth, when they might have been deceived by the alteration to the engine plus fresh paint, one could leave it at that.

But it is extremely difficult to explain the mystery of Nasmyth's drawing, which is on quite a different plane. We know from his autobiography, and from the reproduction in THE ENGINEER of September 12th, 1884, that he sketched an engine at Liverpool within two or three days of the opening.

By permission of the Trustees of the Laing Art Gallery,



NASMYTH'S SKETCH OF THE "ROCKET"

Newcastle-on-Tyne, the drawing to which I referred in my last letter is reproduced. It is evidently by another hand; note the expression "one James Nasmyth." The date is given as 13th. If really the day before the opening, it was, of course, the 14th. Considering Nasmyth's gifts as an engineer and artist, we may take it as established beyond a doubt that, a day or two before the opening, there was an engine on the line with the following characteristics: (1) cylinders at the side of the fire-box, (2) funnel stays, (3) a tender similar to that of the "Northumbrian."

After careful consideration I have come to the conclusion that all the engines down to and including the "North Star" had the cylinders behind the fire-box, with the steam pipes coming out of the back of it, and that the only ones which had the cylinders on the side of it—and the fire-box flush with the boiler—were the "Northumbrian" and "Majestic"—see "A Century of Locomotive Building," page 238. They also had what I call the "Union Jack" frame—see Plate XXII. of my "History," and "A Century," page 235—and truck and barrel tenders. The "Majestic" may be ruled out, as she was not delivered till November. Consequently, assuming that Nasmyth made a mistake in the name, there is only the "Northumbrian" left, and both Mr. Warren and I decided that she must have been the engine sketched. But the funnel stays are a difficulty to which we have perhaps not given sufficient attention. They do not appear on any drawings as part of the original design—the only engine of which there is a representation with them is the "Phœnix"—and seem rather like a cure for a wobble that developed in practice. There is no suggestion elsewhere that the "Northumbrian" ever had them, and if she did, it does not seem very likely that Stephenson would have ventured to remove them just before the opening—they must have been thought desirable, or they would not have been put there.

In the correspondence mentioned by Mr. Holcroft it is stated that the ghost "Rocket" had funnel stays. If Nasmyth's sketch was unknown to its supporters—they would have been sure to have called it in evidence if they had known of it—that is a very strong point in their favour.

In Deghilage's "Origine de la Locomotive" (Paris, 1886) there is a drawing of an engine similar to the one illustrated here so far as small details are concerned, but with the cylinders higher up, and the trailing wheels coupled to the drivers. In the text there is this reference: "1832—La Fusée par Stephenson, chemin de fer de Liverpool-Manchester—Transformation de la locomotive du concours de Rainhill: nouvelle chaudière plus puissante, accouplement des deux essieux.—Dessin reproduit d'après un croquis relevé en mars 1832, par M. Stenson, de Leicester, sur la voie de garage de Fosse-Lane (The Engineer)." Can Stenson be Stretton?

Guildford, January 10th. C. F. DENDY MARSHALL.

SIR,—I have read with much interest the remarks of your correspondents with regard to the existence of the second 'Rocket,' *alias* "Comet." This "Elusive Pimpernel" amongst locomotives has evaded our locomotive historians through the confusion caused by the names it bore, so that they can only describe the story of its life as a myth or refer to it as a "mare's nest."

In my previous letter I drew attention to the correspondence in the *English Mechanic* of 1884–85, from which I was able to compile quite a detailed description of the engine and give the dates of the principal events in its life, from the time of its brief appearance on the Liverpool and Manchester Railway to its eventual disappearance in South Wales, where it vanished into thin air.

When the correspondence ended in 1885 it was generally accepted that the existence of a second "Rocket" was proved, and I am sure your correspondents would also agree if they read it. Unfortunately, it is too long to reproduce, but a few extracts may be of interest as a reply to some of the doubts raised as to the engine's existence.

Mr. Warren, for instance, explains away Nasmyth's drawing of the second "Rocket" in the *Mechanic's Magazine* of October 16th, 1830, by suggesting that he must have sketched the "Northumbrian" and named it "Rocket." "Nun. Dor," writing to the *English Mechanic* of November 7th, 1884, says: "Mr. Nasmyth's drawing represents an engine something like the 'Northumbrian,' but he shows stays to the chimney, which the 'Northumbrian' has not in the engraving." "Historian," writing on the same date, says: "The 'Rocket' tried on the Liverpool and Manchester and then sent to the Swannington Railway, was exactly like Mr. Nasmyth's drawing in THE ENGINEER, but with the altered trailing wheels and side rods added."

Again, "Old Swannington Servant," writing on February 13th, 1885, remarks: "I remember the old Swannington 'Rocket' as well as possible, with outside, oblique cylinders."

George Stephenson had a framed copy of the official engine list of the L. and S.R. in his house at Alton Grange, Chesterfield, and this gave engine No. 1 as being the "Rocket," afterwards re-named "Comet," and the position of cylinders as outside oblique.

Mr. Solomon, quoting Clement Stretton, says that "Comet" was No. 4 on the list and had inside cylinders, but this does not appear to be correct, although it is possible that the name was transferred to No. 4 after the first engine was sold in 1835. H. HOLCROFT.

January 13th.

A Visit to the Works of J. H. Holmes and Co., Ltd.

For many years the firm of J. H. Holmes and Co. has held a prominent position in the electrical industry. Established in 1883, the firm is one of the oldest electrical manufacturers in Great Britain, and it is well known that until recently the works were at Newcastle-on-Tyne. About two years ago, however, the business was taken over by J. H. Holmes and Co., Ltd., and new works were acquired at Hebburn-on-Tyne, adjacent to the New Town Works of A. Reyrolle and Co., Ltd., with whom the firm is

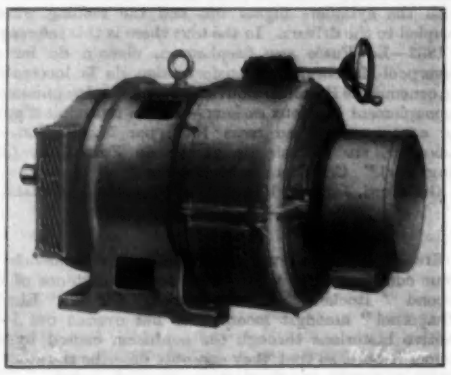


FIG. 1—A.C. COMMUTATOR MOTOR

now associated. The lay-out of the new factory, to which we have recently paid a visit, conforms in every way with modern ideas. Special attention has been paid to such things as lighting, inter-departmental communication, and up-to-date machinery, whilst the new situation also facilitates the interchange of information between the two firms on all matters relating to research and design.

The well-known Holmes products are still being manufactured, as well as various other products that are needed to meet the requirements of modern industry. One of these new products is a variable-speed A.C. motor. Originally the motor was designed as part of the Holmes rotary web printing press driving equipment, but it has since been developed to meet the requirements in other industries in which a smooth speed variation is required from an A.C. machine. Two types of this motor are made. One has a characteristic similar to that of a series-wound D.C. motor, and the other—see Fig. 1—with a shunt characteristic. Speed control is obtained by moving the brushes in accordance with the recognised principle, whilst the machine is started by means of a simple three-pole switch. The machine with series characteristics consists of a stator with a core and winding, as employed in an induction motor, and an armature with a low-voltage winding, as used on a D.C. motor. A three-phase transformer is connected in the stator circuit, and the secondary windings give a supply to the commutator brush gear. The control of the motor is effected by movement of the brush rocker, by means of a hand wheel, but if desired a small pilot motor may be provided to enable the machine to be controlled from a distance. To obtain a low starting current and a high starting torque, it is only necessary to ensure that the brush rocker is placed in the starting position, and the brush rocker movement from the starting position to the high-speed, full-load position must always be made in the reverse direction to that in which the motor revolves.

A diagram of connections for the motor is given in Fig. 5. The speed of a motor of this type is, of course, independent of the number of poles and for any given setting of the brushes the speed rises as the load is reduced, as in the case of a D.C. series machine. With the brushes in the limiting high-speed position, however, the motor speed does not increase rapidly as the load decreases, the characteristic under this condition being the same as that of a compound-wound D.C. motor, and, in general, a device for cutting out the machine at a runaway speed is unnecessary. Typical speed torque curves for various positions of the brushes are given in Fig. 2. When a constant torque is desired the best working range of speed should be kept within 3–1, but this range can be increased to 4–1, when the torque falls off as the speed is reduced. The synchronous speed of the motor occurs at an intermediate value of the speed range, the permissible speeds ranging from 45 to 135 per cent. of the synchronous speed. The regulation of the motor by brush movement eliminates all resistances, and the consequent losses, external to the machine, with the result that the efficiency of the motor is high over the whole speed range. At synchronous speed and above, the power factor approaches unity and only begins to fall off considerably when a speed below 75 per cent. of synchronous speed is reached. Curves giving the power factor and efficiency for a motor with constant torque and a speed range of 3 to 1 are given in Fig. 3, and similar curves for a motor with the torque dropping with the speed in Fig. 4.

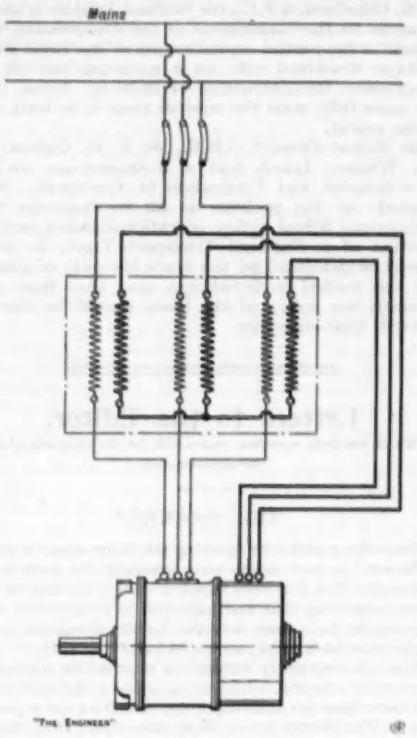
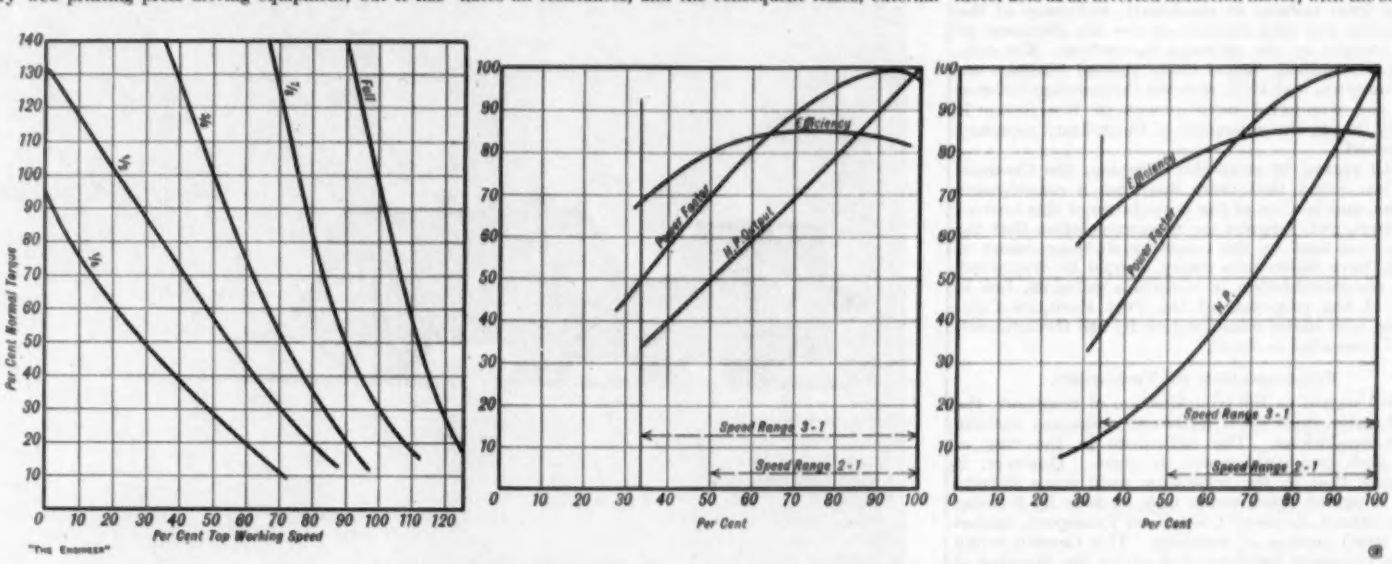


FIG. 5—MOTOR CONNECTIONS

As we have said, the motor was originally developed for the driving of rotary printing presses, on which a constant torque at various speeds is required, but the machine can also be used for many other purposes when the torque or output required is dependent upon the speed. It is not, however, put forward for a job on which the output varies considerably at a fixed speed. The motor is suitable for driving fans, pumps, and compressors where a variable output is required, and it may also be used with advantage when frequent stopping is essential. The motor has been applied to the driving of spinning frames in the textile industry; it is also suitable for use where its speed can be kept under constant control by hand or automatic adjustment, according to the load, a condition that frequently applies to small rolling mill drives, as with turntables, traversing gear, and some forms of loading or furnace-charging machines.

The normal design of machine with shunt characteristics has a speed range of 3 to 1, and the synchronous speed is midway between the minimum and maximum speeds. As in the case of the motor just described, the whole range of speed is obtained by shifting the brushes by means of a hand wheel. The rated output is proportional to the speed, and, with a fixed brush position, a practically constant speed is maintained, as the speed only falls to the extent of 4–7 per cent. between no load and full load, according to the size of the motor. The efficiency remains high throughout the whole of the speed range, and is about the same as that of an induction motor of corresponding output. As the field strength remains constant, full-load torque and overload are also maintained.

The power factor at synchronous speed also corresponds to that of an induction motor of the same output, but rises and approaches unity at speeds over the synchronous value. The motor consists of an induction motor stator, and a rotor carrying two windings, the upper of which corresponds to a D.C. winding, and is connected to the commutator, whilst the lower winding is connected to three slip rings, which are fed by the primary three-phase supply. The winding on the stator is a three-phase winding with six terminals, so that each stator phase is separate. The commutator is encircled by two sets of brush arms, each set carrying brushes corresponding to the phases of the stator winding to the terminals of which the six brush bands are connected. The two sets of brushes are mechanically connected through the brush-shifting hand wheel or spindle, so that the two sets are rotated in opposite directions, when the hand wheel is operated. The motor acts as an inverted induction motor, with the supply current applied to the slip rings, and a separated three-phase secondary winding on the stator, the secondary commutator winding on the rotor, providing for the speed regulation. Speed variation follows from the insertion of the brush voltage in the secondary circuit of each phase of the stator. The brush voltage across a stator phase winding varies from a positive to a negative maximum,



FIGS. 2 TO 4—CHARACTERISTIC CURVES OF A.C. COMMUTATOR MOTORS

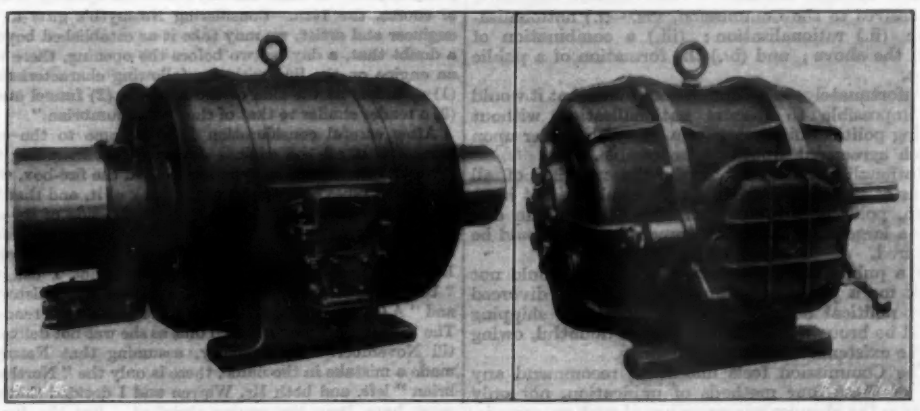


FIG. 6—TOTALLY-ENCLOSED VENTILATED MOTOR

FIG. 7—FLAME PROOF MOTOR

as to two sets of brushes are moved in opposite directions, through a total movement of 360 deg. The setting of the brushes thus controls the base speed at no load, which is decided by the field slip necessary on the stator to give an induced E.M.F. in this winding equivalent to the brush voltage. As the load comes on a greater slip of the field is necessary, and the speed drops until a secondary current to produce the required torque is set up. As the commutator winding is entirely separate from the primary winding, the brush voltage is under the control of the designer, and is chosen to give good commutation. When starting the machine, the brushes are set at the low-speed position, giving the equivalent of a high resistance induction motor, and the machine can consequently be switched directly on to the line with a current rush not exceeding 75 per cent. of the full load current, and a good starting torque is obtained.

A number of these variable-speed A.C. motors of approximately 100 horse-power capacity, are now in operation, and are said to be giving entire satisfaction. Normally, the machines are designed for a speed variation of 3 to 1, but considerably greater ranges can be obtained. Large machines are, in fact, at present under construction for a speed range of approximately 10 to 1. Another development in connection with newspaper printing press equipment is the manufacture of electrically-operated reel stands, which eliminate stoppages during printing, when it is necessary to change from an empty reel of paper to a full reel.

During our visit to the works our attention was also called, in addition to the wide range of A.C. and D.C. standard motors, to totally enclosed external fan motors which have been designed to work in places where the

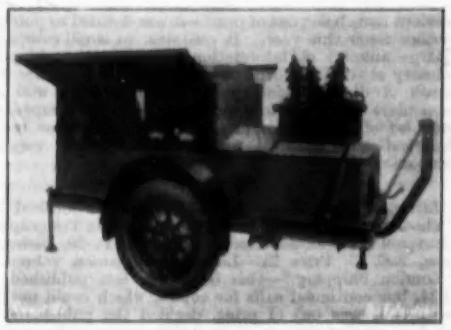


FIG. 8—PORTABLE WELDING SET

atmospheric conditions preclude the use of open machines. Motors of this type do not call for external piping, as required by pipe ventilated machines, and they are installed in exactly the same way as ordinary motors. They consist essentially of a totally enclosed machine with an additional outer casing, and the air is forced through the annular duct formed by the two casings, care being taken in the design to ensure that the cold air is deflected on to the inner shell, so as to give the maximum cooling effect. An external fan ventilated induction motor of the wound rotor type is shown in Fig. 6. Another interesting motor made by the firm is the flame-proof motor shown in Fig. 7. This particular machine is rated at 5 B.H.P. at 760 r.p.m., and is wound for a pressure of 440 volts. The machine is so constructed that when required a switch and a trifurcating box or a switch and a plug or a trifurcating box may be fitted without any alteration of the standard design. The motor shown is provided with a triple-pole non-automatic switch and a Reyrolle flame-proof plug for the incoming cable. Still another product that was brought to our notice was the portable "Castle" electric arc welder shown in Fig. 8. These equipments are made in the portable, semi-portable, and fixed types, and, as shown in the illustration, they are metal-clad and shower-proof. The sets consist essentially of a specially-designed welding generator which may be driven by an electric motor, a petrol engine, or other prime mover. The generators have a drooping voltage characteristic, and are simple to operate.

Electrolytic and electro-plating generators have been manufactured by the firm for many years, and have been supplied to many industries. Good commutation on machines of this type is a matter of great importance, for otherwise brush renewals are liable to involve considerable expense. In the design of these machines, therefore, special attention has been paid to the commutation and to the question of minimising contact drop, which is essential in low-voltage machines in order to obtain a reasonable efficiency.

On account of its situation in one of the chief centres of the shipbuilding industry, the firm has long devoted attention to the manufacture of marine electrical equipment, and since 1883 electrical plant has been installed on more than 1000 ships.

MANCHESTER ASSOCIATION OF ENGINEERS.

AT a meeting of the Manchester Association of Engineers, held on the 9th inst., a paper on the "Design and Construction of Rayon Machinery," was read by Mr. John M. Heyes. The paper dealt with the preparation of viscose, spinning, reeling, washing and drying, bleaching and the necessary auxiliary plant. The necessary machinery for all these processes was illustrated and described by the author, who said that the manufacture of artificial silk was still in the evolution stage, and that experiments were still being made to cheapen production, as well as to make it more continuous than at present. A process had been evolved to do the steeping, pressing and kneading of the pulp continuously. There remained many problems for the rayon mill engineer to solve with the co-operation of the chemist and scientist. The pollution of rivers and streams with poisonous effluents and the liberation of unpleasant fumes into the atmosphere should engage the attention of mechanical engineers.

Copper-Back Boilers in Kitchen Grates.

THE following statement regarding the use of copper-back boilers in kitchen grates has been issued by the Copper and Brass Extended Uses Council :—

The city of Birmingham gas department has recently carried out some extensive tests relative to the use of copper-back boilers in kitchen grates. The results have a public interest.

For years past copper has been used as the material for back boilers, particularly where the nature of the local water was such that, with iron, comparatively rapid rusting was probable. A few plumbers and domestic engineers doubted the material, but its quality approved itself with use. But serious doubt arose as to whether, where copper was installed, coke could be safely used as fuel; and some engineers advised definitely no coke where a copper-back boiler was in use. It was supposed to facilitate external corrosion, so that a leaky boiler would soon eventuate.

The Birmingham gas department ultimately concluded that the matter was of sufficient importance to justify a complete test. The Copper and Brass Extended Uses Council co-operated, being anxious to establish on a firm basis what was felt to be the service copper could give. Moreover, with the possibility of a partially carbonised coal for general use coming nearer, it was felt that our knowledge of the reactions of such fuel should be extended.

The test fell into two parts. First, four boilers were fired with ordinary coke, as sold for household use, under the conditions and for the hours of daily use general with kitchen boilers, for a period of 206 days. At the end of the time they were taken out and examined. One boiler was an ordinary commercial saddle-back boiler; make and history unknown, just purchased in an ordinary way as an example of a general trade product. It was of about $\frac{5}{16}$ in. plate. Two, same size and shape, were made of hot rolled copper plate, $\frac{1}{4}$in. substance—used to get a definite standard—and of specially refined copper to carry out ideas the C. and B.E.U. Council had formed upon that point. The fourth was a boiler, same size and shape, of similar $\frac{1}{4}$in. hot rolled copper, but of ordinary refining.

The test appeared inconclusive. No one of the boilers showed any sufficiently marked corrosion to justify calling it inferior. The two boilers made of specially refined copper showed a trifle less of corrosive action than the ordinary $\frac{1}{4}$in. plate copper boiler. Some evidence also suggested, to a very slight extent, that the somewhat smoother finish of cold rolled copper might make a better boiler than was the case with ordinary hot rolled copper. It was accordingly decided to reshape and repeat the test.

The one trade boiler made of commercial copper and the two boilers of specially refined copper, of $\frac{1}{4}$in. plate, were tested again. The ordinary refined $\frac{1}{4}$in. plate boiler was discarded. Two new boilers, each of cold rolled, specially refined, $\frac{1}{4}$in. copper were added; and one also was added with its external surface specially treated by a trade process supposed to prevent corrosion, and known to possess some value with materials other than copper.

The three first tried boilers were then fired with a coke made especially and unduly high in sulphur, so as to make the test far severer. One of the new cold rolled specially refined copper boilers was fired with similar coke, and also the surface-treated boiler. The other new boiler was fired with ordinary coal to give a comparison. All six were fired with such frequent running off of hot water and letting down of fires, as to give external condensation every chance of causing corrosion. Conditions far severer than those of the ordinary kitchen were thus set up. The test was continued for 195 whole days—approximately 12 hours each—and 39 half days.

The boilers were dismantled in October, 1930. Careful examination was made of the external condition of each, both before and after cleaning, external deposit was examined, both visually and chemically, and all other necessary observations made. The conclusions to be drawn from the complete double test were :—

(*a*) No boiler was seriously corroded; the worst was very sound; nothing even suggested leaks. The entire suitability and serviceableness of copper for back-boilers is confirmed.

(*b*) The surface-treated boiler showed in patches a marked deterioration of surface. There was not enough evidence to show whether, or not, the copper itself was injured; but it is a fair conclusion that surface treatments are neither necessary nor desirable with copper.

(*c*) The one boiler tested with coal showed more of a very slight surface corrosion than any of the boilers used with coke, although three of the latter had been in use 206 days longer, and although the coke used for the 195 days, plus half days, of the second test had been made more severe, in its potential corrosive activity, than ordinary coke could be. The idea that coke might be a corrosive fuel with copper is entirely disproved.

(*d*) The boilers made of cold rolled copper showed no superiority in condition over those made of hot rolled. While, therefore, reasonable smoothness in surface of the copper for boilers is desirable, a sufficient smoothness can be obtained by hot rolling.

(*e*) The two boilers made of a specially refined copper, although they have been through the double test, were sufficiently superior, in surface condition at the end of test, to the others to justify the conclusion that this copper is preferable.

(*f*) In case of any surface corrosion, the extra thickness of boilers made from $\frac{1}{4}$in. plate is a factor of safety. It is, however, not an essential, but can be recommended.

(*g*) Some points in the manufacture of the boilers are clearly of importance. The brazing should be well done and finished smoothly; rough places in brazing may give a lead to corrosion. Internal protrusions of brazing should also be avoided. Indeed, it should be of advantage to boilermakers to study the autogeneous welding, with copper, to see if it is not a superior process. The design should avoid external projections due to overlapping of copper; there is evidence of a possible wastage due to corrosion wherever any such external projection is permitted. The bending of the "wrapper-plate" of the boiler should be accomplished with a minimum of strain, tension, roughening, or thinning of metal at bend; there is evidence that smooth and even thickness bends leave the copper at its full strength to resist corrosion potentialities.

It may be added that, in the discussion which has taken place among those who have examined the tests, mention has been made of the character of the setting as possibly delaying or aiding corrosion. It appears very desirable that there should not be crevices between setting and copper in which the products of combustion can settle. Also it is a suggestion that a layer of neutral fire-clay, between brickwork and copper, would be very well worth while, or a "stone-ash" wash, between setting and boiler, is another device worth trying.

SIXTY YEARS AGO.

LOOKING back, we can see that sixty years ago military armaments, in spite of the great progress which they were thought to show, were only just emerging from the state of development in which Napoleon knew and used them. Smooth-bore cannon had not as yet completely disappeared, mussle-loading small arms were being converted into breech-loaders, machine guns had just made their first appearance and gunpowder was still the only explosive used either as a propellant or as a bursting charge. At sea the self-propelled torpedo remained an inventor's dream. The turret ship was still a novelty, and there were many people who argued that it was folly to depart from the broadside principle, which had served Nelson and his captains so well. The Franco-Prussian war may justly be taken as marking the beginning of a new and intense period of development in military science. The Victorian mentality had to seek some source of philosophic consolation that would palliate the application of current progress to the destruction of one's fellowmen. It found it in the axiom that in proportion as the means of destruction were developed so would the aggregate horrors of war be decreased. That argument will hardly be sustained by anyone of the present age. Still it served, or was made to serve, as an apology for the introduction in those days of an ever-increasing terror into the development of military armaments. We find it advanced, for example, in our issue of January 20th, 1871, as an excuse for advocating the development of the war rocket. We used it in anticipation of the objections of those who we knew would complain of the barbarity of the weapon. If Paris were to surrender to the Prussians it would be best that it should surrender quickly. Friendly though we were to the French, we argued that the sharpest means of bringing the Parisians to capitulation were justified on the grounds of humanitarianism. In the war rocket we saw such a means. At the battle of Leipsig in 1813 the only English troops present were a party of Congreve rocketers. Their missiles, newly invented, resembled ordinary pyrotechnic rockets with a stick at one side. They proved terrible in their effects. Sir William Congreve was wont to argue that war rockets had the power of artillery without its weight, but in use the absence of accuracy in their aim proved a serious disadvantage. Many improvements were made in them at a later date, notably by Hale, who discarded the stick and gave the rocket a rotary motion in flight by means of tangential fire vents. Rockets for many years remained in use in the British and Austrian armies, and in certain campaigns, such as that in Abyssinia, they proved to be very useful, for they could easily be conveyed over ground that would be impassable to guns. In the rocket we felt we had the only means of taking advantage of the new explosive, liquid nitro-glycerine. That substance was too dangerous to handle in ordinary ammunition and too sensitive to withstand the shock of being fired from a gun. It might, however, be used, so we held, as an explosive head for rockets. The Germans, we wrote, would never destroy the forts round Paris with the artillery which they had in the field. As well might they fire apples or oranges at them. The use of rockets with nitro-glycerine heads would, we suggested, enable them to effect their object. Our advice proved unnecessary. Paris capitulated ten days later, not to the force of the Prussian bombardment, but to starvation.

IRON AND STEEL PRODUCTION IN 1930.

THE National Federation of Iron and Steel Manufacturers reports that during December the number of furnaces in blast fell to seventy-six; of the sixteen furnaces which ceased operations eleven were "damped down." Production of pig iron in December amounted to 349,800 tons, compared with 384,100 tons in November and 643,000 tons in December, 1929. The production included 91,400 tons of hematite, 122,700 tons of basic, 105,300 tons of foundry, and 18,300 tons of forge pig iron.

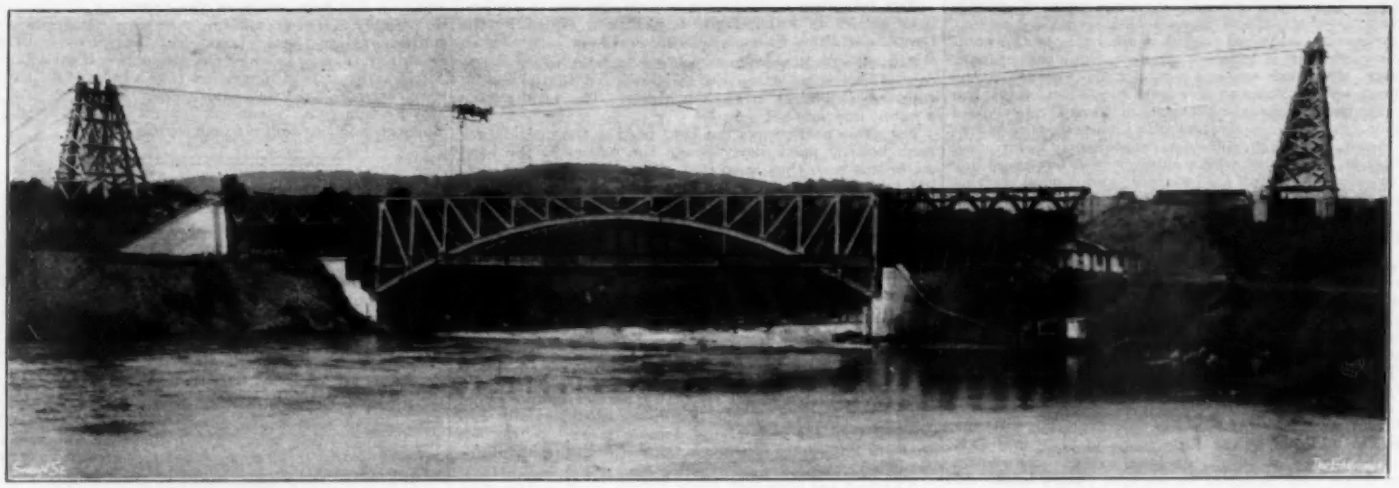
The December output of steel ingots and castings amounted to 337,200 tons, compared with 432,800 tons in November and 661,200 tons in December, 1929. The December production brought the total production of pig iron for the year to 6,196,800 tons, and of steel to 7,298,500 tons, compared with 7,589,300 tons and 9,636,200 tons respectively in 1929.

The following table shows the average monthly production of pig iron and steel ingots and castings in 1913, 1920, 1928 to 1930, and the production in each month since December, 1929 :—

	Pig iron. Tons.	Steel ingots and castings. Tons.
1913 monthly average	855,000	638,600
1920 " "	669,500	755,600
1928 " "	550,800	710,000
1929 " "	631,600	804,600
1930 " "	516,400	608,200
1929—December	643,000	661,200
1930—January	650,000	771,100
February	607,000	776,400
March	665,800	826,100
April	619,600	696,100
May	614,500	691,900
June	563,200	600,100
July	486,100	621,400
August	416,700	451,300
September	425,000	580,600
October	415,000	512,500
November	384,100	433,800
December	349,800	337,200

NEW BRIDGE OVER THE NILE AT JINJA, UGANDA

P. AND W. MACLELLAN, LTD., GLASGOW, ENGINEERS



A New Nile Bridge in Uganda.

UGANDA is divided by the natural barrier formed by the river Nile and the lakes Kioga and Kwania into two provinces. The Eastern province which produces the greater part of the cotton crop is comparatively well served by railways, as a glance at the sketch map will show, but the Western province has hitherto only been connected with this railway system by a service of steamships on Lake Victoria. This service of ships is based on Kisumu, the original terminus of the Kenya and Uganda Railway. In 1928 the Uasin-Gishu Plateau line was extended into Uganda, having its terminus at Jinja. This extension caused the Nakuru Junction–Kisumu section of the old main line to lose much of its importance, for, whereas previously the products of the Eastern Province had passed, *viâ* Lake Victoria and Kisumu, to Mombasa on the coast, this traffic was then diverted along the line having its terminus at Jinja.

On Wednesday, January 14th, a new road and rail bridge across the Nile at Jinja, within sight of the Ripon Falls, was opened by Sir William Gowers, Governor of Uganda, together with an extension of the railway to Kampala. The event signalises a very considerable advance in the development of railway transport in the Protectorate; the erection of the bridge gives the Western Province of Uganda direct railway communication with Mombasa and the sea coast, and gives better and more rapid transport facilities to the traders in the province than the old steamship service across Lake Victoria could provide.

The new bridge, of which we reproduce a photograph, is noteworthy for the fact that it is the only bridge spanning the river between its source and Kosti, about 1300 miles further down stream. It consists of a spandril braced arch, 260ft. 2in. long, with an approach span 100ft. long at each end. The railway is carried on a top deck over the arch. A 20ft. roadway is suspended below the arch and there are two footways, one on each side of the roadway. The railway lines are 69ft. and the roadway 35ft. above flood level. It is worthy of notice that the structure has been built wide enough to carry a 3ft. 6in. gauge line in case an alteration from the present metre gauge may be thought necessary in the future. The bridge was completely erected on its own bearings in the builders'—P. and W. MacLellan, Ltd.—yard at Glasgow and was afterwards dismantled and shipped to Uganda in sections.

The new railway line to Kampala was authorised in August, 1928, and work on it was begun in the following December. The distance between Kampala and Mombasa is now 886 miles by the railway. The cost of the extension is estimated to have been £493,178, or approximately £8521 per mile. This comparatively high cost per mile is partly due to the costs involved in bridging the river. The bridge alone is stated to have cost between £75,000 and £80,000.

The new line will serve country already producing sugar, power alcohol, coffee, rubber, and timber. There are already seventeen coffee and rubber plantations owned by Europeans along the route. There is very little doubt that it will stimulate settlement in the Southern Kyagwe district, where there is believed to be a large acreage of land available for the purpose, and it will provide quick transport facilities for the large native population in the district through which the line passes. There are three stations between Jinja and Kampala.

Kampala, the present terminus of the railway, is at the centre of a wide, well-populated district. Owing to its excellent geographical position, it appears to be certain that in time it will become an important distributing centre. Future extensions of the railway westwards are likely to augment its importance still further.

The sketch map shows the geographical position of the new bridge and of Kampala, and indicates the probable position of the projected extension westwards towards Mubende and the Belgian Congo.

SKETCH MAP SHOWING POSITION OF NEW BRIDGE

Books of Reference.

London (and Southampton) Shipping. Published by "The Journal of Commerce" and "Shipping Telegraph." Liverpool: 17, James-street. London: 14–20, Bishopsgate, E.C. 2. Price 2s.—This little volume, which claims to be "a complete Directory, Personal and Official, to the Shipping and Associated Interests in the Ports of London and Southampton," has not been published since 1924, but, in response to many inquiries for copies—the previous issue being out of print—it was decided to publish another issue this year. It contains, in small compass, a large amount of information regarding the shipping industry at the two ports. This information includes the names of directors and principal officials, as well as particulars of the services maintained by the companies, and also of the vessels in their fleets. In some cases historical and financial notes respecting the various companies.

Liverpool (and Manchester) Shipping. Published by "The Journal of Commerce" and "Shipping Telegraph." Liverpool: 17, James-street. London: 14–20, Bishopsgate, E.C. 2. Price 2s.—Like its companion volume—"London Shipping"—this book was last published in 1924, but continued calls for copies, which could not be met, as it was out of print, decided the publishers to produce another edition. Like its companion volume, too, it contains a very large amount of information likely to be of service to those having to do with ships and shipping at the two ports with which it particularly deals. There are, also, three coloured plans showing, respectively, the Liverpool Docks, the Birkenhead Docks, and the docks at the head of the Manchester Ship Canal.

The Colliery Manager's Pocket Book, Almanac and Diary for the Year 1931. London: The Colliery Guardian Company, Ltd., 30 and 31, Furnival-street, Holborn, E.C. 4. Price 3s.—Little is necessary for us to say regarding this old-established work of reference—it is now in its sixty-second year of publication—beyond the announcement that this year's edition has made its appearance. No doubt it will be welcomed by those to whom it is specially intended to be useful as cordially as have the volumes which have appeared in past years.

The Concrete Year Book, 1931. Concrete Publications, Ltd., 20, Dartmouth-street, Westminster, S.W. 1. Price 3s. 6d.—This book of reference has now reached its eighth year of publication and requires no detailed introduction from us. The handbook section, we are told in the preface, has been again completely revised in order to bring it up to date with current practice and to cover developments during the past year. New chapters (*a*) on Bridges, dealing with design according to the requirements of the Ministry of Transport, and (*b*) on Joints in Concrete Work, have been included. Both the Directory Section and the Catalogue Section have been increased in size. A list is also given of chapters which have appeared in previous editions, from 1924 to 1930 inclusive, which are not repeated in the 1931 edition.

The "Practical Engineer" Electrical Pocket Book for 1931. Oxford University Press. London: Humphrey Milford. Price 2s. 6d.—Among the new matters introduced into this—the thirty-second annual—issue is that describing some modern methods of remote control by electrical means of valves, such as those used in large water circulating systems and for the regulation of exhaust steam. Particulars are also given of some recent changes in the construction of the plates of standard types of secondary batteries. As usual, too, the volume has received its customary annual revision, and will, no doubt, be found as useful as have been its predecessors. Like its companion volume, "The 'Practical Engineer' Mechanical Pocket Book," it contains a buyers' guide and technical dictionaries in French, Spanish and Russian.

The "Practical Engineer" Mechanical Pocket Book and Diary. Oxford University Press. London: Humphrey Milford. Price 2s. 6d.—We are told in the preface to this—the forty-third edition—of this justly popular book of reference, that its contents have been carefully revised and that several improvements have been effected. Some notes have been re-written or amended to record or reflect the most recent developments of research and practice; while new notes, illustrations and tables, for the most part relating to topics not prevously included, have been introduced to a considerable volume. The principal alterations and additions concern liquid fuels; water-tube boilers; steam valves; fuel economisers; newly introduced apparatus combining in a single unit the functions of an ordinary fuel economiser with those of a heater for passing the air into combustion chambers; and wire ropes. The book also includes, as usual, dictionaries in French, Spanish and Russian, as well as a buyers' guide.

Sanitary Engineering in 1930.

No. II. (*Conclusion*).*

Birmingham.

Improvement to the Rivers Tame and Rea.—Under the powers of the Birmingham Corporation (Rivers Improvement) Act, 1929, work was begun on the improvement of the river Tame between Sweetmoor Bridge, Coleshill, and the point where it is joined by the river Rea at Bromford. The work at present in hand consists in widening to 75ft., the banks being sloped at an angle of 45 deg., and revetted with lump slag bedded in concrete. Flood banks are being constructed to prevent the flooding of adjacent lands during periods of maximum discharge. The work is being carried out as an unemployment relief works scheme with Government assistance.

East Birmingham Sewerage.—In connection with the proposed extension of the city on the eastern side, to include an area of some 4555 acres, a sewerage scheme has been prepared to drain a portion of the Cole Valley and its tributaries. The scheme provides for 5014 acres of the city of Birmingham—including the area proposed to be added—and 10,306 acres of the adjacent rural districts of Meriden and Solihull.

Sewerage of Perry Barr.—Good progress was made with the sewering of the Perry Barr area, which was incorporated in the city in 1928. Two sections of that scheme are now practically completed, the sum expended on the work in 1930 amounting to approximately £34,700. Work is now in hand on the third section of the scheme, estimated to cost £250,000, which is being carried out with Government assistance as an unemployment relief works.

Handsworth Main Sewerage.—Owing to the building developments which have taken place in Handsworth in recent years, the present main sewerage has become inadequate, and serious flooding occurs from time to time in the low-lying portion of the district during periods of heavy rainfall. A scheme has therefore been prepared for reconstructing the main foul water sewer and certain branch foul water sewers, and for widening, deepening, and culverting portions of the brook course which discharge into the river Tame near Perry Barr station. The estimated cost of this work is £109,000, and it is hoped to put it in hand during the forthcoming year.

Unemployment Relief Works.—Good progress was made in the sewerage works included in the City Council's relief works programme. In addition to the works already mentioned above, contracts have been entered into for sewer reconstruction and extensions, estimated to cost £155,700, and the work was well in hand at the end of the year.

Coventry.

In 1928 the boundaries of the City of Coventry were extended by Act of Parliament, increasing the area from 4147 acres to 12,878 acres. The population of the city in 1921 was 128,157, and it is now estimated to be 175,000. In order to cope with the extension of the city and the large increase in population during the past decade, extensive works of sewerage and sewage disposal had to be taken in hand. Several of these schemes were mentioned in our last year's Review, and during the past year considerable progress was made in the construction of the works.

The sewerage of the added area in Allesley was practically completed at a cost of about £15,000, the contractors being W. H. Jones and Son, Ltd., of Coventry. The flood prevention schemes and the widening of bridges and culverts on the river Sherbourne were undertaken, and most of the works were carried out by labour employed direct by the City Engineer's Department. At the sewage disposal works at Baginton, a new sludge digestion scheme was completed, at a cost of £24,000, by direct labour, employing 50 per cent. of men drawn from the depressed mining areas. This scheme is now at work, and is producing good results. It is, however, only an instalment of the larger sludge digestion scheme which the engineers have in view, and it is intended shortly to put in hand further works for dealing with sludge by the digestion method. At the Whitley storm water works new pumps and rising main, decanting valves, &c., were installed. The new Finham Sewage Disposal Works are in course of construction, and about 19,000 tons of granite filtering media were dumped on the site by the contractor for the supply of the media, Mr. J. G. Gray, Coventry. The contractors for the works are Messrs. Johnson and Sons, Mirfield, Yorks, and they made good progress with the extensive excavation works necessary for the tanks, bacteria beds and humus pits. A considerable amount of concrete and constructional work has been put in, and it is expected that during the present year the main portion of the works will be completed. The approximate amounts of these contracts are: Construction of sewage disposal works, £91,000; supply and delivery of filtering media, £33,000; total, £124,000.

Croydon.

At the Beddington Sewage Works of the Croydon Corporation, which deals with a part of the borough, an investigation is being made of the activated sludge process of sewage treatment. The present population draining to the works exceeds 200,000, and with the approval of the Ministry of Health several local authorities at the south of the borough have made arrangements to discharge their sewage to these Croydon works. The result will be that in a few years a very large population will have to be dealt with; in fact, the Croydon works might be regarded as a buffer between the North Downs and the London main drainage area. The general system of sewage treatment has for some years been screening, sedimentation, filtration, and land irrigation. The sewage farm has an area of 684 acres. At present there are in operation two activated sludge plants, the first on the "Simplex" system treating about 1½ million gallons per day, and the second on the "paddle and channel" system, dealing with nearly the same quantity. A third activated sludge plant on the "diffused air" system is now nearing completion, and will, it is hoped, be brought into operation early in the present year. This plant will probably deal with about 2,000,000 gallons per day. The position will then be rather unusual, in that these three systems will be in operation side by side. The present intention is to transform the farm from an irrigation to a sludge disposal area. This work it is proposed to accomplish by passing the effluent from the percolating filters into humus tanks, and thence direct to the river instead of irrigating over the land. Storm water will be dealt with in new tanks—now in course of construction—and the effluent from the latter will be passed over a specially under-drained area, and away to the river. These measures will release about 75 per cent. of the available irrigation area for the purpose of sludge disposal. The activated sludge process as operated at Beddington aims only at a partial purification, the treatment being completed by passing the effluent from the activated sludge plants through the percolating filters, and thence to humus tanks and river. Dry-weather flow only is treated in these plants. In a year or two Mr. G. F. Carter, M. Inst. C.E., the Borough Engineer, proposes to come forward with a scheme for dealing with 10 to 12 million gallons per day. At present about £150,000 is being spent on the sewage works and farm.

Caterham and Warlingham.—In this connection it may be explained that, during the year, the sewering of the whole district of Warlingham has been in progress. The work comprises the laying of 14 miles of sewers, including a deep 12in. tunnel about 1 mile long. The drainage from this area is to discharge into the new Caterham Valley sewer, referred to elsewhere, which will convey it to be treated at the Croydon disposal works.

Guildford.

The Corporation of Guildford, during the year, entered into a contract with Hussey, Egan and Pickmere, Ltd., for the construction of sewage disposal works. Detritus tanks, screens, storm-water tanks, primary sedimentation tanks, and mixing and balancing tanks are being constructed in such a way that some of the tank effluent may still be treated on land by irrigation and the balance diverted to new bacteria beds and humus tanks. The expenditure on these works may be anticipated as about £50,000, and the work is being carried out to the designs and under the supervision of Messrs. Dodd and Watson, of Birmingham.

Ipswich.

Good progress was made during the year with the high-level intercepting sewer, estimated cost £74,000. To date, approximately a mile has been laid, partly in tunnel and sizes of pipes generally up to 4ft. 6in. diameter and depth up to 30ft. Since the construction of this sewer was begun, further main tributary sewers have been approved and a start has been made on one of them. It is estimated to cost £15,400, and it will comprise tubes up to 33in. diameter. A contract for the new sewage disposal works was entered into with Messrs. A. Jackaman and Sons, of Slough, and the work was actively started about two months before the end of the year. So far the work has chiefly consisted of mechanical excavation of the ground to a maximum depth of about 19ft., and demolition of part of the existing sewage tanks preparatory to constructing new reinforced concrete sedimentation tanks, which are estimated to cost about £67,000.

Leeds.

The progress made with the Leeds sewage disposal scheme at Thorpe Stapleton during the past year included the completion of the construction, at the Low Level works, of the second unit of sewage purification settlement tanks, with all the necessary contingent conduits, channels, &c. The contract amount for these works was about £40,000. The construction of the three units of sewage purification settlement tanks was begun and good progress was made, during the year, the contract amount being about £25,000. An extension of the small sewage disposal works of the city, which are situated at Rodley, was sanctioned. This work, which involves an expenditure of about £25,000, will be carried out during the present year.

Leicester.

The new sewage disposal works, which had been in progress at Leicester for some time, were formally opened on October 16th. Leicester lies in a basin and all of its sewage has to be pumped 167ft. for treatment. The original Beaumont Leys disposal scheme, which was completed in 1891, consisted in the erection of the Abbey Pumping Station—where the engines are of the beam type—the laying of 1¼ miles of 33in. rising mains, the construction of sedimentation tanks, &c., at Beaumont Leys, and the draining of land to make it suitable for broad irrigation. In 1894 an 8ft. diameter storm outfall culvert, costing £80,000, was constructed from the Abbey Pumping Station to Wanlip, 4 miles away, its discharging capacity being 80 million gallons per day. In 1902 it was decided to erect a further pumping station at Belgrave to pump the sewage from that district to Beaumont Leys Farm, and to lay down new sedimentation tanks and contact beds. In 1912, in order to provide for increase in population, Mr. E. Geo. Mawbey, in consultation with the late Mr. G. Midgley Taylor, prepared a scheme of extensions which, however, was postponed, partly owing to opposition and partly owing to the war. In 1920, however, the comprehensive scheme which was completed last year was formulated by Mr. Mawbey, begun in 1924, and brought to a conclusion by Mr. A. T. Gooseman, M. Inst. C.E.—the present City Engineer and Surveyor.

The new works comprised (*a*) the construction of four detritus tanks, each 108ft. long and 20ft. wide; (*b*) the construction of five underground storm water tanks with a total capacity of 2½ million gallons; (*c*) the construction of a 16ft. by 5ft. storm water culvert; (*d*) the laying of a 44in. diameter rising main between Abbey Pumping Station and Beaumont Leys to supplement the original 33in. main; (*e*) the building of a new Abbey Pumping Station containing three sets of electrically-driven triple-ram Tangye pumps, with a capacity of 16½ million gallons per day; (*f*) the building of what are known as the New Valley Works at Beaumont Leys, comprising percolating filters, effluent pumping station, &c. The estimated cost for the whole work was just under £648,000.

Manchester.

Davyhulme Sewage Works Extension.—The construction of the culvert to carry the effluent from the projected activated sludge units from near the main entrance of the outfall works to a point on the Ship Canal just below Barton Locks was completed during the year, and provides an additional outlet to the canal. Contracts have now been entered into for the final section of the extension scheme approved by the City Council and the Ministry of Health some years ago. This section deals, *inter alia*, with all work incidental to the construction and equipment of activated sludge plant for the treatment of a D.W.F. of 16 million gallons per day—with due proportion of storm water—by the diffused air method of applying the process and some 2 million gallons per day by (*a*) the "Simplex" method, and (*b*) the Sheffield vertical paddle—Haworth—method of applying the process. This work was recently begun.

Secondary Digestion of Sludge.—In extension of the research work on the digestion of sludge, published in the Annual Report of the Department for the year ending March, 1930, two demonstration-scale digestion tanks have been constructed. They are thoroughly equipped with means for measuring rate of gas evolution, temperature control, &c. These tanks will come into operation early in this year, and it is hoped that it will be possible to obtain reliable data in respect of the economics of the process in relation to the problem of sludge disposal at the Davyhulme works.

Wythenshawe Drainage.—Consequent on the inclusion within the city of the parishes of Northenden, Baguley and Northern Etchells, work was begun on the first section of the main Wythenshawe drainage. The undertaking will comprise a western intercepting sewer, 7ft. 3in. diameter brick; an eastern intercepting sewer, 8ft. 6in. diameter brick; the Northenden sewer, 3ft. 3in. diameter to 5ft. diameter, brick sewer; a storm water overflow chamber and outlet to the river Mersey, 12ft. 6in. by 7ft. 11in., semi-circular; and a 4ft. 9in. diameter outfall sewer, which includes a syphon under the river Mersey.

Nottingham.

Reference was made in our last Annual Article to the Nottingham Corporation's £1,000,000 main drainage and sewage disposal scheme, for which parliamentary powers were obtained in 1929. Considerable progress was made with this work during the past year. Contract No. 1, comprising the construction of a portion of one of the main sewers in the city, for which Messrs. Lewis and Beck, of Birmingham, are the contractors, was, at the end of the year, rapidly approaching completion. The construction of the outfall sewer from the city to the sewage disposal works, over 2½ miles in length, was let in two contracts—to Messrs. H. Arnold and Sons and Swift, Bros. and Haslam, both of Doncaster—and in each case the work was well advanced. The laying out of the sludge area and underdraining additional land at the disposal works by direct labour was commenced. It is hoped that contracts will be placed for further works, including the construction of settling tanks, storm

* [No. I. appeared January 9th.

tanks and a new pumping station early in the present year.

Poole.

The parish of Kinson, in the Rural District of Poole, will come within the boundaries of the County Borough of Bournemouth early this year. In the meantime a comprehensive sewerage and sewage disposal scheme is being carried out for the Council by Messrs. Dodd and Watson, of Birmingham. The first contract, amounting to about £62,500, was entered into early in the year with Dare, Pettigrew and Co., Ltd., and another contract has recently been entered into with Hussey, Egan and Pickmere, Ltd., for £31,000, the works comprising the construction of sewage purification works on a site adjacent to the river Stour.

Rothwell.

The Rothwell (Yorkshire) Urban District Council put into service an interesting disposal plant. A peculiarity of the plant is that the drainage gravitates to two pumping stations, the flow to one of which is some five times as great in volume as is the flow to the other. The two stations are equipped with the same number of electrically-driven pumps, all of them of the same capacity, but whereas the pumps in the first station are, when there is sewage to lift, run for fifty minutes in each hour, the pumps in the other station are only run for ten minutes. This interchange of stations is effected automatically from the disposal station in accordance with the flow of sewage, as are also the starting and stopping of the pumps. We described the whole plant so recently—see THE ENGINEER for October 24th last—that there is no need to go into further detail at the present time.

Sheffield.

During the year good progress was made in the construction of four additional units of the bio-aeration plant. These units will complete the scheme of twenty-two units, each capable of treating one million gallons of sewage per day, together with the appropriate volume of storm water. Two of the four units will be ready for operation during the present year. Progress was also made in the construction of 12 acres of sludge drying beds, together with the necessary electrically-driven pumps, pump wells and mains. The combined scheme is estimated to cost £134,000.

A scheme is now before the Ministry of Health for a new sewage disposal works at Woodhouse Mill, estimated to cost £36,000. It will consist of a bio-aeration plant in which several new features are to be incorporated, sludge digestion plant and sludge drying areas. It is expected that this work will be begun during the next three months.

Southend-on-Sea.

The £275,000 sewerage and sewage disposal scheme which was undertaken some years ago by the Corporation of Southend-on-Sea, and to which reference was made in our last Annual Article, made excellent progress during the year. The 60in. cast iron pipe outfall, which is being laid under contract by Howard Farrow, Ltd., was completed to a point 2050 yards from the beach, but another season's work may be anticipated before its completion. The 3-mile length of 5ft. diameter effluent conduit, which will discharge sewage from the works at Prittlewell to the sea outfall, was completed by G. Shellabear and Son, Ltd. A 9in. cast iron sludge main was laid from the works at Prittlewell to the Corporation's sludge lands in the parish of Barling, near the river Roach, and application was made to the Ministry of Health for authority to proceed with the construction of the necessary detritus tanks, screening bays and sedimentation tank at Prittlewell, in order to comply with the Corporation's Act of 1926. The consulting engineers, Messrs. Dodd and Watson, MM. Inst. C.E., expect to be able to start this work early this year.

Stoke-on-Trent.

Substantial progress was made with the development of the sewage disposal scheme for Stoke-on-Trent, to which we referred in our last Annual Article. Practically the whole of the reinforced concrete work was completed, the bacteria bed walls and floors were laid in, and the whole of the storm and sewage tanks, together with a large amount of incidental work, were also completed. The work of filling the beds with filtering material is now proceeding, and it is hoped to have the 6 acres completed by the end of July of this year. The pumping station and outfall mains are being held up temporarily, pending the decision of the question of treating sewage from certain outside districts at the new works, which will affect both the size of the pumping plant and mains concerned. The estimated value of this work to be done is approximately £70,000. An important improvement to a brook course, which was also in progress during the year, comprises a concrete invert which is being formed to improve the waterway, for a distance of about 2500 yards, the estimated cost of this work being £60,000.

Wolverhampton.

Until four or five years ago the sewage of the borough of Wolverhampton, after treatment with milk of lime and settlement in tanks, was finally purified on land. With the increase in the size of the borough, and the advent of new manufactures, extensions at the sewage works became necessary, and two million-gallon units of bio-aeration plant were installed. During the year they were worked successfully, and are now dealing with slightly less than half the dry-weather flow. It is now proposed, on the advice of Messrs. Dodd and Watson, of Birmingham, to utilise the bio-aeration plant for flocculation and partial purification of the whole of the sewage and to complete the purification on filters. The new installation will include detritus, sedimentation, sludge digestion, and humus tanks, sludge drying beds, a sludge pumping station, and an effluent conduit and outfall. The estimated cost is about £90,000. The new detritus tanks, which are furnished with mechanical scrapers, were nearly completed, and good progress was made with the construction of the sludge digestion tanks. Primary settlement tanks, filter beds, humus tanks, and storm-water tanks have yet to be constructed. The sludge after digestion will either be dried on drying beds or sent direct to the surrounding farms as at present. The cost of the works included in the present scheme is estimated at £230,000.

France.

The year was one of preparation for the vast sewerage scheme in Paris, which, it is announced, will be put in hand during the present twelve months. With the considerable extension of Paris, alike in area and population, partial measures are no longer possible to meet the growing needs, and nothing more can be done, except to construct the new sewerage system around the city for the collection of sewage in the immediate suburbs, partly for decantation and mainly for delivery to the farms which are to be laid out beyond the existing sewage farm at Achères. It is a vast undertaking, involving an expenditure of about 3000 million francs, and its execution will occupy about twenty years. The scheme is strongly opposed by the populations along the valley of the Seine, where the new sewage farms are to be created, and they are endeavouring to secure the passage of a Bill through Parliament for the suppression of sewage farms throughout France on grounds of public health. The Paris engineers declare that the scheme is a necessity, and that the creation of new farms must be authorised on the ground of "public utility." This collision of interests may cause some delay to the scheme, and possibly modification of it. In the same way, there has been trouble over the question of refuse disposal. The companies contracting for the incineration of refuse in Paris are giving satisfaction to the public and to themselves, but when the Prefect of the Seine endeavoured to impose the same system on the suburban municipalities, he met with opposition on the ground of cost and public health. As a means of avoiding a deadlock, the Superior Council of Health decided to organise some trials, during the present year, of plants for the destruction or utilisation of refuse. At Lyons a German incineration plant was being laid down during the year, and it is hoped to produce with it the electrical energy necessary for recharging the batteries of public service vehicles.

The Quarter's Shipbuilding Returns.

FROM the statistics issued by Lloyd's Register of Shipping regarding vessels under construction at the end of December, we note that in Great Britain and Ireland there was a decrease of 207,844 tons in the work in hand as compared with the figures for last September, and that the present total—908,902 tons—is 651,352 tons less than the tonnage which was being built at the end of December, 1929. This decrease is the largest ever recorded during twelve months, with the exception of the year 1922, which was affected by the completion of the shipbuilding programme occasioned by the war. It may be of interest to state that about 134,000 tons of the tonnage now in hand in this country are intended for Norway; about 17,000 tons for the British Dominions; and about 139,000 tons are for other foreign shipowners or for sale.

The tonnage now under construction abroad—1,417,184 tons—is only about 35,000 tons less than the work which was in hand at the end of September, 1930. The totals for the end of December, 1930, do not include the tonnage being built in Russia, from which country no returns have been received. Five countries abroad have more than 150,000 tons under construction, viz.:—United States, 232,030 tons; Germany, 218,215 tons; Italy, 179,677 tons; France, 174,215 tons; and Holland, 160,078 tons.

The total tonnage under construction in the world amounts to 2,326,086 tons, of which 39·1 per cent. is being built in Great Britain and Ireland, and 60·9 per cent. abroad. The average percentages in the last twelve months before the war were 57·2 for Great Britain and Ireland and 42·8 for abroad. In Great Britain and Ireland 131,995 tons were begun—a decline of about 29,000 tons from the similar figures for the September quarter, and 296,843 tons were launched, a decrease of about 82,000 tons. Similar figures for abroad are 288,666 tons begun and 332,545 tons launched. A decrease of about 203,000 tons as compared with the record figures for June is shown in the tanker tonnage under construction in the world, the present figures being 115 vessels of 907,298 tons, of which 48 vessels of 388,897 tons are being built in Great Britain and Ireland and 16 vessels of 143,250 tons in Germany. It is significant that of the 115 tankers under construction 104 are motor ships. The tanker tonnage now being built represents over 39 per cent. of the total steam and motor tonnage under construction in the world.

During the first three quarters of 1930 the tonnage of motor ships under construction in Great Britain and Ireland exceeded that of steamers being built, but the present figures, 440,276 tons, are 23,740 tons below those of the steamers. The motor ship tonnage being constructed abroad—892,433 tons—exceeds by nearly 72 per cent. the tonnage of steamers. The continued progress in the employment of the internal combustion engine for large vessels is indicated by the fact that while there are now being built in the world 68 motor ships of between 8000 and 15,000 tons each, only 15 steamers of such size are under construction. As regards vessels of over 15,000 tons, the totals comprise 17 steamers and six motor ships.

The table respecting marine engines shows that the horse-power of steam engines now being built or being fitted on board amounts to about 1,342,000 horse-power, while the figures for oil engines aggregate about 1,052,000 horse-power. The figures for steam engines include fifty-eight sets of turbine engines of about 1,063,000 shaft horse-power, giving an average of 18,300 H.P. per set. The horse-power of the steam reciprocating engines—279,575 H.P.—is less than 12 per cent. of the total horse-power of marine engines now being built in the world.

LARGE SPARKS.

THE last lecture of the series on "The Electric Spark," which Professor A. M. Tyndall has been delivering before juvenile audiences at the Royal Institution, dealt first with illustrations of long sparks which can be obtained by special transformers on a large scale. Million-volt transformers giving sparks several feet in length are, it was explained, available in this country and in America. Illustrations were given of the types of discharge they produce on the surface of wires or through the air or over the surface of insulators in a storm of rain. But, the lecturer continued, "Nature caps all the efforts of man in lightning." The general appearance of a lightning flash was copied by a brilliant spark, 8ft. long, over the surface of some gilt wallpaper. In lightning we have, he said, electric sparks a mile or more in length, passing either from a cloud to the ground or from one part of a cloud to another. Benjamin Franklin first showed the electrical state of a thundercloud by a flying kite, but nowadays the investigation of lightning has reached a quantitative basis. The voltage of a lightning flash can be estimated by measuring the induced charge that is set free on an isolated portion of the ground when a flash passes at reasonable distance from it. In America the surge, set up in a model power transmission line when a flash passes near it, is used to produce a Lichtenberg figure on a photographic plate. These figures produced by sparking over the surface of a sensitive plate are very beautiful illustrations of the ramifications of electrical discharge.

A thousand million volts is a not uncommon voltage in lightning flashes. Such tremendous voltages require enormous concentrations of positive and negative ions in different parts of a cloud. Experts differ in their opinions as to details, but it seems clear that a production of ions and subsequent separation can be produced when water drops are broken up, whether by convection currents or by electrical distortion. To illustrate the fact that rain is electrified, the lecture sprayed a fine jet of water over a sensitive electroscope, and obtained a measurable deflection.

The total energy dissipated continuously in lightning flashes is of the order of 2000 million horse-power. Evidence of distant thunderstorms is obtained from the atmospherics which trouble us in broadcasting. Special methods of counting have led to estimates of as many as 200 atmospherics per second by day and 3600 per second by night, coming from distances of 2000 miles and originating in lands where the time and season is summer afternoon.

The lecture concluded with a brief consideration of the many problems of lightning protection, both of machinery and of buildings. The final experiment was a replica of the famous electric cage experiment of Faraday, who showed that an observer with delicate instruments inside the cage was completely protected from all electrical effects, such as those of sparks to the cage, from electrical machines outside it.

NEW MONTROSE BRIDGE.—In the note regarding the opening of the New Montrose Bridge, which appeared in our issue of the 9th inst., we omitted to state that the contractors for the erection of the structure were Sir Robert McAlpine and Sons.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—On Friday, January 9th, the annual dinner of the Institution of Structural Engineers was held at the May Fair Hotel, London. A company of about 450 ladies and gentlemen were present, under the chairmanship of the President, Mr. R. H. Harry Stanger. The toast of "The Institution of Structural Engineers" was proposed by Sir Clement D. M. Hindley, and was responded to by the President. In the course of his remarks Sir Clement Hindley, dwelling upon the value of research to structural engineers, stated that in America, with wages from three to five times as high as those paid in this country, the study of economy in building construction had brought down costs to within a small margin of the costs in Great Britain. He referred to the building known as Thames House, on the banks of the Thames, as a vivid example of the introduction of new and scientific methods in British building construction. In his reply to the toast Mr. Stanger said that within the past year a great movement had taken place in the direction of bringing building methods and building by-laws up to date. Two bodies were now at work on the questions involved, namely, the Steel Structures Research Committee, over which Sir Clement Hindley presided; and the Technical and Economic Advisory Council, formed by the Royal Institute of British Architects. It was right, he added, that the Institution, with its 3500 members, should be, as it was, in close touch with both these bodies. The toast of "The Guests" was proposed by Major A. H. S. Waters, V.C., D.S.O., M.C., Vice-President of the Institution, and was responded to by Captain J. F. C. Bennett, the Mayor of Westminster. Following the dinner and the speeches a dance was held.

Railway and Road Matters.

IT is announced that the National Wages Board will start its review of railwaymen's pay and conditions of service on Monday, January 19th.

WHEN, as related in this column on January 2nd, Sir Herbert Walker was speaking at a dinner of the staff of the Southern Railway general manager's and secretary's offices, he also said that the cost of the electrification to Brighton would be about £3,000,000, and, with luck, there would be an electrical service to Brighton by the summer of 1932.

IN view of the growth of road motor traffic, it would seem that the lamps on level crossing gates should have their visibility improved so as to guard against the gates being run into and damaged by road vehicles, accompanied possibly by an obstruction on the railway. This remark is prompted by two recent accidents—a fatal one at Retford and a remarkable escape at Coppull in Lancashire—which was due to the road being slippery owing to frost.

FROM time to time we mention the inquiries of the Assistant Inspecting Officers of Railways into the more serious accidents to railway servants. Colonel Mount's annual report for 1929 shows that those officers and the sub-inspecting officers held 460 such inquiries during the year. In only 215 of these cases was it thought necessary to make any recommendation; in 167 instances the recommendation was accepted and in 36 it was declined. The remaining 12 cases were still under consideration.

AS far as we can see, no name associated with British railways appears in the list of New Year Honours, and the only officer of note among those overseas is Mr. Percy Rothera, the agent of the South India Railway, who receives a Knighthood in the Indian list. Mr. Herbert Morrison, the Minister of Transport, becomes a Privy Councillor, and Mr. Charles Campbell, one of the Sub-inspecting officers of the Railway Department of the Ministry, is made a Member of the Order of the British Empire.

OUR contemporary, the *Railway Review*—the organ of the National Union of Railwaymen—in its issue of January 9th, drew attention to the fact that during 1929 the four grouped companies paid more than £539,000 in connection with merchandise carried by goods train and over £66,500 for consignments by passenger train which had been lost or damaged in transit. It is then remarked that "We feel confident that it is only necessary to once again draw attention of railwaymen to this important matter in order that the figures mentioned above may be substantially reduced during the coming year."

THE fatal accident to three trainmen at Northumberland Park Station, Tottenham, on January 7th, recorded, along with the Carlisle accident, in our Seven-day Journal on January 9th, was of a very unusual character. We may say that, besides the coroner's inquest, the circumstances will be inquired into by Colonel Anderson on behalf of the Ministry of Transport. We have reason to believe that, although there are special operating regulations for gunpowder vans, there are none for petrol tanks. We would have it remembered, too, that on September 19th, 1927, a passenger train ran broadside into a train of thirty petrol tank wagons—fortunately empty—at Plaistow.

THE Underground authorities always have deserved credit for the attractive design of their posters, and four recent examples deserve special mention, in that they bring home to the passenger some of the special features provided for the safety of the trains. These respectively show the "dead man's handle," whereby, should the motorman accidentally release his control whilst running, current is cut off automatically and the brakes applied; the tunnel telephone that enables a motorman to "plug in" at any point on the line and to communicate with the sub-station; the automatic train stop, which "trips" the motor should a signal be overrun; the escalator safety gear for stopping it in an emergency. An inset shows the particular apparatus in a larger scale.

IT is well known that the Metropolitan Railway is considerably handicapped in its train service to and from the City lines by the bottle-neck of only two lines of way between Baker-street and Finchley-road. In order to find some relief, powers were obtained in 1926 to make a tube railway between Edgware-road and Willesden Green, but the line has not been proceeded with. A letter in *The Times* of January 10th makes what, if the companies concerned would agree to it, would, in our opinion, provide an excellent remedy against this congestion. The former Midland main line and the Metropolitan come within 100 yards of each other at West Hampstead, and the proposal is to lay in a junction at that point which would allow for Metropolitan trains from the City to run over its own widened lines up to King's Cross and thence over the old Midland Railway *vid* St. Paul's-road Junction to West Hampstead. We would add, as corroboration of the nearness of the two lines at that point, that there used to be, and probably still are, sidings at West Hampstead for exchanging traffic between the two companies.

THE Board of Trade export tables for November show that the value of the railway material sent overseas during the first eleven months of the present year was as follows; the corresponding figures for 1929 and 1928 are added in brackets: — Locomotives, £3,576,879 (£2,971,833, £3,203,733); rails, £2,044,648 (£2,534,812, £3,238,964); carriages, £1,725,535 (£2,218,259, £2,357,899); wagons, £3,004,890 (£2,270,735, £2,947,243); wheels and axles, £362,573 (£397,580, £696,215); tires and axles, £612,436 (£569,086, £547,515); chairs and metal sleepers, £597,737 (£479,072, £827,089); miscellaneous permanent way, £806,892 (£952,854, £1,227,485); total permanent way, £4,524,813 (£5,074,813, £6,658,944). The weight of the rails exported was 235,998 tons (301,138 tons, 371,836 tons), and of the chairs and metal sleepers, 62,603 tons (48,000 tons, 83,697 tons). During the month of November last locomotives of the value of £56,647 were shipped overseas, which included the Argentine, £240,264; India, £195,754; South Africa, £44,940. During the same month rails of the value of £64,292 were exported, which included the Argentine, £21,173; Portuguese East Africa, £13,130; British South Africa, £3816; Straits Settlements, £3080; Australia, £2340; and India, £2075.

Notes and Memoranda.

THE number of operatives employed in the cotton mills of Bombay during last year was 232,087, which shows an increase of 13,000 over 1929.

THE average daily production of motor tires in France was 14,100 pieces during the past year. The annual consumption was about 2,900,000 tires.

THE Pacific Gas and Electric Company is adopting a pressure of 1200 lb. per square inch for the boilers of its new station at San Francisco. The three boilers will have a total evaporative capacity of 500,000 lb. per hour.

IT is said that the cost of hardening and tempering rock drills by means of the electrically heated salt bath is, on the Rand, less than one farthing per drill. This amount includes power, maintenance, depreciation, labour and supervision.

IT is claimed that the tank which is being made by Braithwaite and Co. for the Murree waterworks in the Punjab, will be the largest pressed steel tank in the world. It will be 204ft. by 160ft. by 16ft. deep and will have a capacity of some 3,250,000 gallons.

IN a lecture given to the Royal Society of Arts, Professor C. R. Darling said that theoretically, 20,000 cubic feet of air, which represent the contents of a house of moderate size, may be raised in temperature from freezing point—32 deg. Fah.—to 64 deg. Fah. by the heat produced from the combustion of 1 lb. of coke, and when the air is once heated only losses due to cooling by conduction through exposed walls and windows and the entry of fresh air from without have to be made good by the furnace. He also pointed out that, at present prices in South London, the relative amounts of heat obtained from one pennyworth of fuel are as follows:—Gas coke, 60,000 units; household coal, 57,000; semi-coke, 45,000; anthracite, 40,000; oil, 11,400; coal gas, 11,100; electricity, 3415 units.

WRITING in the *Canadian Engineer*, Mr. P. H. Wood, of the Converse Bridge and Steel Company, suggests the use of several colours in the painting of bridges. "I will admit," he says, "that unless it was done under artistic supervision the effect might be terrible. Also, the span would have to be of graceful outline to start with. During the war the French painted a number of their railway bridges in a similar fashion to the way ships were camouflaged. A number of colours were used and the effect was certainly startling. From even a short distance away they looked like anything but a bridge. The same ingenuity by artists on steel highway bridges would achieve pleasing results, particularly if the design of the span was æsthetically satisfactory. A variation in effect might be achieved by applying stainless steel, or possibly aluminium alloy sheets to some of the principal members."

AT a recent meeting of the French Academie des Sciences in Paris, Mr. A. d'Arsonval described a new Röntgen-ray tube capable of working at 400,000 volts. It was in 1913 that Mr. W. D. Coolidge invented the type of tube in which the electronic current is produced by emission from an incandescent cathode. Up to 1928 it was considered, says the *Electrical Review*, that 200,000 volts was the maximum which such a tube could withstand, although Coolidge had already produced a tube working at up to 350,000 volts and two and three-stage tubes for from 600,000 to 900,000 volts, while later experimental tubes for pressures up to 1 million volts in fifteen stages had been produced. Mr. d'Arsonval pointed out that all those advances had, however, been confined to research laboratories, and that so far there was no systematic production of tubes for 400,000 volts. The new d'Arsonval incandescent-cathode tube is a sealed single-stage bulb, which, at a constant voltage of 400,000 volts, carries 2 milliampères, while with a pulsating voltage of 400,000 volts it will carry an average of 2·5 milliampères. This has been achieved by mounting the cathode filament within a round metallic component, the air in which is, by extending the exhausting action, entirely withdrawn. The new tube is being manufactured by the Gaiffe-Gallot and Pilon Company, of Paris, and is made in lengths up to 43·5in., with bulb diameters of from 190 mm. to 200 mm. The distance between the anode and cathode is 40 mm., and the diameter of the metallic sleeve 25 mm.

THE temperature of solids may be estimated by the eye or accurately measured by means of a thermometer, thermo-couple, or optical pyrometer. Flames, particularly non-luminous flames, present a more difficult problem. A flame may, according to the American Bureau of Mines, be hot enough to melt platinum and yet look fairly cool to the eye. Conversely, there are certain luminous cool flames which will not burn the hand. This is because the radiation from flames does not follow the laws which apply to solids; for example, much of the radiation from the ordinary Bunsen type of flame is in the invisible infra-red region of the spectrum. In a method for measuring flame temperature being employed at the Pittsburgh Experiment Station of the Bureau, the flame is coloured yellow with sodium vapour and the intensity of this light compared in a spectroscope with the light from a heated solid at known temperature. The work is being carried out as one phase of a study of the physics and chemistry of gaseous combustion and explosion. Values have been obtained for statutory flames of different mixtures of air with methane, ethane, propane, butane, iso-butane, ethylene, propylene and butylene. Maximum flame temperatures vary from 1880 deg. Cent. for methane to 1975 deg. Cent. for ethylene. The mixture of gas and air which gives maximum temperature does not correspond to that which gives maximum flame speed, except for methane and Pittsburgh natural gas. For all other hydrocarbons tested, the mixtures which produced the highest flame temperature contain less combustible gas than those which give the highest speed of flame. The percentage of combustible gas in air which gives maximum flame temperature is slightly on the rich side of that required for exact combustion to carbon dioxide and water. Maximum calculated temperatures are 40 deg. to 70 deg. Cent. higher for the saturated hydrocarbons and about 100 deg. Cent. higher for the unsaturated hydrocarbons than the experimental values. Radiation losses account for the lower measured temperatures.

Miscellanea.

THE new free port at Piræus, Athens, is to be opened in April.

AN aerodrome is to be constructed in Andorra by a Barcelona firm.

THE cost of extending the piers in New York Harbour, to accommodate 1000ft. liners, is estimated at £15,000,000.

THE annual carnival dance of the Imperial College is to be held at the Union, South Kensington, on February 20th, at 9.30 p.m. Tickets may be obtained from Mr. D. M. Tombs.

ACCORDING to an analysis by the *Engineering News-Record* of America, the state of Vermont expends most on the maintenance of roads, with an amount of 37·80 dollars *per capita*.

THE Department of Overseas Trade has just issued a booklet of "Hints for Commercial Visitors to Turkey," which has been prepared by the Commercial Secretary to H.M. Embassy at Istanbul.

IT appears, from statistics recently issued in America, that, on the average, each locomotive of the Pennsylvania Company consumes nearly 2500 tons of coal per annum. The company owns 6100 engines.

THE recent extended fog in the Manchester district is said to have resulted in a record in electricity generation. On January 6th the local power stations produced 2,113,000 units, which is at the rate of 770 millions a year.

IT is proposed to construct an embankment 12 miles long, with an average height of 20ft., at Sangywa, Rangoon, with the object of forming an artificial lake to provide potable water for the city. It is estimated that the lake would give a supply of 47½ million gallons of water a day.

THE City Council of Edmonton, Alberta, has decided to expend 450,000 dollars on the extension of the boilers in its power plant, and will probably order further plant to the amount of 1,445,000 dollars during 1932–33. This second programme will include a 15,000-kilowatt generator.

THE announcement is made that the New England Power Association, a subsidiary of the International Hydro-electric System, has a construction programme involving an expenditure of upwards of 5½ millions sterling. On completion of the programme, which includes the construction of the fourth largest hydro-electric plant in the U.S.A., the Association will have a total hydro-electric capacity of 467,300 H.P., in addition to steam-driven plant of approximately the same horse-power.

THE laboratory for carrying out large-scale experiments on hydrogenation of coal established at Duisburg by the A.G. für Steinkohleverflüssigung und Veredelung has, says the *Iron and Coal Trades Review*, been closed. This step has been found necessary, due to the fact that owing to the want of suitable materials for the parts of the plant exposed to very high pressures these were very quickly worn out. The same trouble has prompted the I.G. Farbenindustrie to curtail considerably its activity in the field of hydrogenation of coal.

THE official returns rendered to the Electricity Commissioners show that 1150 million units of electricity were generated by authorised undertakers in Great Britain during the month of December, 1930, as compared with 1049 million units in the corresponding month of 1929, or an increase of 9·6 per cent. During the year ending December 31st, 1930, the total amount of electricity generated by authorised undertakers was 10,869 million units, as compared with 10,294 million units for the year ending December 31st, 1929, representing an increase of about 5·6 per cent.

THE Commercial Secretary to the British Embassy at Istanbul, Turkey, reports that a revised draft Bill designed to introduce the metric system of weights and measures has been submitted to the Budget Commission of the Grand National Assembly. The Bill prohibits the use of other measures in all contracts, agreements, invoices, commercial books, notices, documents, &c. A translation of the Bill may be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1 (reference 22583/26). It will be recalled that a similar Bill was introduced in 1926, and again in 1928, without becoming law.

AT a recent meeting of the 1820 Settlers' Association at Cape Town, the organising secretary, Captain Edwards, explained the circumstances in which 29 Scottish riveters who were brought out from the Clyde to work on the Northern Rhodesia copper mines returned to Scotland after ten weeks. He said, according to the *S.A. Mining and Engineering Journal*, these men had come out on a contract of 25s. a day, and had refused to carry it out because certain casual workmen were getting 28s. 6d. a day. They complained that on their arrival at the mines they found that though their earnings with overtime amounted to £55 a month, casual workers from Johannesburg engaged on the spot earned, with overtime, as much as £60 a month. The men, who had not come out under the auspices of the Association, which had merely been asked to befriend them, said they preferred the dole in England to £55 a month in Rhodesia as long as there were men worth less earning more.

THE Home Secretary gives notice that in pursuance of his powers under Sec. 47 of the Workmen's Compensation Act, 1925, as extended by the Workmen's Compensation (Silicosis and Asbestosis) Act, 1930, he proposes to make a scheme to provide for the appointment of a medical board to give the necessary certificates in all cases where compensation is claimed for silicosis or asbestosis, and to carry out periodic medical examinations of workers employed in certain specified processes involving exposure to silica or asbestos dust. He further gives notice that he proposes at the same time to amend the Metal Grinding Industries (Silicosis) Scheme, 1927, and the Various Industries (Silicosis) Scheme, 1928, with a view (1) to provide for the certification by the medical board of cases arising under these schemes, and (2) to extend the right to compensation to workmen. He further proposes to make a scheme—to be cited as the Asbestos Industry (Asbestosis) Scheme, 1931—to provide for the payment of compensation by employers of workmen employed in certain processes involving exposure to asbestos dust.

THE AUTOMATIC MANUFACTURE OF AUTOMOBILE FRAMES

THE A. O. SMITH CORPORATION, MILWAUKEE, ENGINEERS

(*For description see page 66.*)

FIG. 5—SIDE-BAR SHAPING AND ASSEMBLAGE

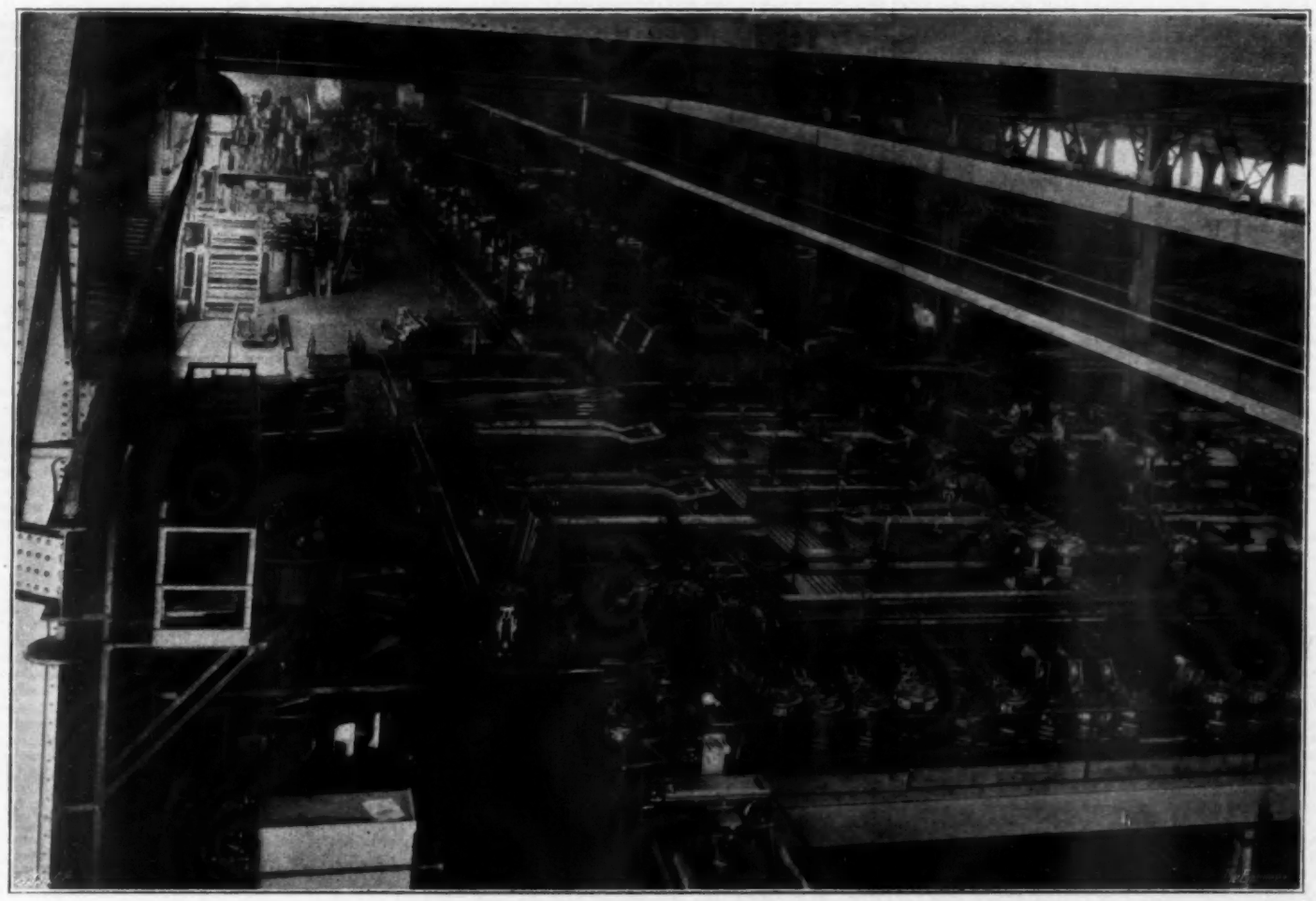


FIG. 6—SIDE-BAR AND FRAME ASSEMBLAGE

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THE ENGINEER.

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JANUARY 16, 1931.

Transport in Large Cities.

ON another page of this issue we give a summary of the final report of the Royal Commission on Transport. The Commission has examined very thoroughly all the problems confronting each of the separate forms of transport undertakings, and its comments upon them will be studied with interest. But with regard to one of the chief aims for which it was brought into being—the Co-ordination and Unification of Transport throughout the country—it found itself unable to make any recommendation. While we cannot but express regret that it could not come to any decision on that point, it seems to us that its failure to do so was almost inevitable. The problem is so vast that it must take many years of consideration before unanimity on the question of the method to be pursued to effect the very desirable end in view can be reached. Yet the evidence collected by the Commission, and the possible solutions examined by it, will go far towards clearing away lumber, and discrediting the arguments of uninformed critics.

In the meantime, however, it appears possible that something might be effected towards nation-wide co-ordination by attacking vigorously the transport problems presented by large towns. Not only because the experience gained as to the method of control adopted would be of inestimable value when the larger problem came up for reconsideration, but also because the necessity for some control is becoming essential. A little has already been done in the direction of co-ordination. In London, for instance, the Underground Railway system and the London General Omnibus Company have been placed under one management, and, perhaps, in time, the civic tramway services, with them, will be brought under common control. But most of the efforts of civic authorities, so far, have been made with the object of reducing the number of vehicles using the streets, without at the same time affecting the facilities for transport. This can only be regarded as a temporary expedient. The London County Council Statistics for 1926–27 demonstrate fully that the number of persons travelling in London is steadily increasing year by year, and, in consequence, the means of locomotion, too, will have to increase in order to meet the needs of the public. But increase of traffic facilities involves the enlargement and improvement of urban highways. As long ago as 1666, Sir Christopher Wren foresaw that the traffic through London must inevitably increase, and submitted a design for the rebuilding of the City after the Great Fire, which could hardly be bettered by the architects of the present day, but his proposals were rejected, and the City was allowed to grow up again around the old congested streets. In spite of the efforts of a number of far-sighted men since that date, little has been done to make the streets meet the demands of the traffic upon them. To quote the report of the Commission, "speaking generally, there is no direction in which such a lack of vision has been evident as in the failure to cope with the great increase in the volume and speed of modern traffic in most of the great cities." Great opportunities have been lost. Much rebuilding has been done, and still is being done, in London and other large cities; yet the opportunity thus presented to widen streets and provide adequate spaces for "roundabouts" has not infrequently been missed. Sooner or later these things will have to be done, but every year the expense of doing them increases. In 1910 the Board of Trade, in a report on London Traffic, put in a plea for the formation of some scheme of development which would keep the facilities in the London streets abreast of the progress of the vehicles using them, and it is pointed out in that report that the improvements to roads would confer benefits, not only on the public, but also on the local authorities, by increasing the rateable values in the districts through which the improved thoroughfares ran. In this connection the building of Kingsway may be cited. The gross expenditure on acquiring the land and constructing the roadway was about £4,980,000, and the value of the land now held is estimated at about £5,016,000. These figures illustrate as clearly as could be desired the fact that the expenditure upon the construction of a great highway through a city may be a directly profitable investment. In other words, the destruction of property necessitated by the widening of the thoroughfare is more than offset by the augmented value of the new property.

The Royal Commission, which had to deal with a problem far greater than that of London alone, could hardly be expected to make any recommendations with special regard to the traffic of the Metropolis. The problem must be faced by the various authorities themselves concerned. If delays, such as those experienced in reaching a decision one way or the other regarding the Charing Cross Bridge scheme, are to occur whenever some major improvement is contemplated, it appears that some central authority capable of making, and willing to make, decisions will have to be set up. It will be recalled that in 1926 the London and Home Counties Traffic Advisory Committee recommended that the whole of London's traffic facilities should be brought under a common management. It was held that, given co-ordination, a sufficient margin of profit would be earned to provide for a steady policy of development. Last autumn the Minister of Transport outlined a scheme of co-ordination for London traffic with which, he said, the Government proposed to proceed at once. The details of the scheme were summarised in our issue of October 10th. They cover the grouping of all the metropolitan transport systems with the exception of the railway companies' suburban lines under the control of a statutory body similar to the Port of London Authority or the Metropolitan Water Board.

The Bursting of Water Mains.

ALTHOUGH the Metropolitan Water Board stated some time ago that the bursting of water mains in London of recent years was not excessive, having regard to the wide extent of the area of supply and distribution, yet to the average person the bursts seem to have occurred with disquieting frequency. That the Works and Stores Committee of the Board, which is responsible for maintaining supplies of water, was not quite satisfied with the situation, is proved by the fact that, in the early part of 1929, when several serious bursts had occurred, it appointed a Sub-committee to make a special investigation into the whole question. The report of that Sub-committee has recently been made public. With its appendices, it forms a quarto volume running to 120 pages or so, and it is profusely illustrated. The whole subject appears to have been carefully gone into, and the document bears evidence of the fact that the Board's engi-

neers were fully aware of the factors tending to cause deterioration and failure in the metals from which mains are made. As an example of this preparedness, it may be pointed out that at the very first meeting of the Sub-Committee, the Chief Engineer intimated his intention to report to it on, amongst other things, the conditions under which cast iron pipes were laid during the early part and middle of the nineteenth century; the depths at which those mains were laid; the mode of constructing roads; the traffic then using the roads and the great increase in traffic in recent years; the decrease in camber in the more recent methods of road construction; vibration; the action of soil on cast iron and steel pipes; electrolysis; the reduction of stability by reason of the operations of other public undertakers, highway and sewer authorities, and the crowding of streets with other mains, pipes, cables, &c., causing one work to impinge on another, *e.g.*, tramways, sewer manholes, brick pits, &c. It must be admitted that these subjects cover a great deal of ground.

The Sub-Committee carefully studied these and many other matters, and draws attention, early in its report, to the preliminary pronouncement on the subject of the bursting of water mains, which was published by the Board in the early part of 1929. In that pronouncement, on which we commented in our issue of February 22nd of that year, it was explained that fractures of mains may be caused by a variety of circumstances, including (i.) changes of temperature, (ii.) traffic conditions, (iii.) interference with the support of mains during road operations, &c., and (iv.) deterioration of the iron by the surrounding soil. The Sub-Committee then proceeds to summarise those and other causes of failure. In all, there are fourteen headings in this summary, and among those which are not included in the Board's original references may be mentioned:—(*a*) Excessive vibration caused by traffic when a main is too near the surface; (*b*) a direct blow from traffic transmitted through walls of a pit or solid concrete placed immediately over a main; (*c*) subsidence of the ground owing to deep foundations for adjoining buildings or by pumping operations for the reduction of the level of sub-soil water; (*d*) excessive depth of cover over an unprotected main; and (*e*) faulty casting of pipes, *e.g.*, cold shut, cooling stress, sponginess, unequal thickness of metal, &c. Any one of these circumstances, it is pointed out, may set up strains, and though the main affected may not show any immediate leakage, a rapid change of temperature of the water, in addition to one or more of them, may complete the damage. As the outcome of its inquiry, the Committee declares that its investigations have resulted "in the fullest disclosure of the circumstances in which the bursting of water mains takes place," and expresses itself as satisfied that nothing further can be done so far as the mains now laid are concerned, except to inspect and overhaul them when any reasonable opportunities occur. As to the future, however, it lays it down that the relative merits of all available pipe-making materials must be considered in relation to the functions of the mains and the soil in which they are laid. "The issue at the moment," it continues, "appears to concern the use of ordinary sand-cast iron pipes, 'spun' iron pipes and steel tubes." Although it is impracticable, owing to the varying natures of the soil in which the mains are laid, to formulate hard-and-fast rules, yet the Committee says that it is of opinion that, in future, steel pipes adequately protected should—with due regard to cost—be used for trunk and large high-pressure pumping mains. The use of steel, it is pointed out, would obviate, as far as possible, the occurrence of inundations which are due to fractures arising from circumstances more generally associated with cast iron. A word of warning, however, accompanies this recommendation. The adequate protection of steel mains by coating is a greater necessity than it is with cast iron pipes, because of their relative thinness and of the more rapid wasting of the steel by corrosion. The cast iron pipe does not perforate so easily as does the steel. It fractures and bursts, with a result which is immediately apparent; whereas, with an inefficiently protected steel pipe, though it may not burst, leakage may go on through perforations for a long time and remain undetected if the water can escape into the sub-soil. Finally, the Committee insists on the paramount necessity of exercising every care in the inspection and testing of pipes, both in the makers' works and when laid. It lays stress, too, on the desirability of the greatest measure of co-operation between statutory undertakers and local authorities, so that the mains may be inspected, as opportunity offers, with a minimum of inconvenience to the general public.

Taking the report as a whole, it cannot be said, we think, to have advanced our knowledge of the causes of the bursting of water mains to any great extent, if at all. So far as we have been able to discover, it reveals nothing which was not recognised before the Sub-Committee began its inquiry. However, even if it does not bring to light any hitherto unsuspected cause of failure, it certainly does point to several things which it is desirable either to do or to avoid. If the Sub-Committee is satisfied, as it says that it is, that it has full knowledge of every circumstance which may cause the bursting of water mains, then we may expect that, with the mains laid in the future, there will not—or need not, if proper precautions be taken—be so many failures as there have been in the past. It is not very comforting, however, to hear that nothing that has not already been performed can be done to existing mains, saving to inspect and overhaul them whenever practicable. It would be a costly business, for example, to open up, at intervals, a busy crossing of thoroughfares in London, or in any other city or town, just to see how the water mains were getting on.

Hydro-Electric Progress in Canada in 1930.

WATER power development, both in the construction of new plants and the extension of existing works, was maintained at a high level throughout the Dominion during 1930, and these activities were not confined to restricted districts, but were general in practically every province.

New installations brought into operation during the year aggregated 397,850 horse-power, bringing the total installation for the whole Dominion to a figure of 6,125,000 H.P. at the end of the year. Construction is active at present on a number of undertakings of outstanding magnitude, and with the completion of these during the next two or three years more than 1,500,000 H.P. will be added to the Dominion's total. Other important projects are under active investigation with development apparently imminent in several cases, while plants recently placed in operation or actively under construction are designed for future extensions as load conditions warrant.

This large programme of construction, which involved a probable expenditure of 80,000,000 dollars during the year just closed and will involve as much as 300,000,000 dollars during the next two or three years, has had and will continue to have a very important influence on employment conditions throughout the Dominion.

During the year the province of Ontario led in new installations with a total of 136,000 H.P., while other undertakings under way in the province involve installations aggregating 442,000 H.P. The Hydro-Electric Power Commission of Ontario completed and brought into operation unit No. 10 of 58,000 H.P. in its Queenston plant on the Niagara River. This brings the Queenston plant, the largest single generating station in Canada, to its full designed capacity of 560,000 H.P. At Chats Falls, on the Ottawa River, which forms the boundary between the provinces of Ontario and Quebec, a joint development is being carried out by the Commission, which has the rights on the Ontario side, and the Ottawa Valley Power Company, which controls those on the Quebec side. The joint power station, which is situated astride the inter-provincial boundary, will have an initial installation of 224,000 H.P. in eight units under a head of 54ft., while provision is being made to increase this to 280,000 H.P. when conditions warrant.

In the province of Quebec new water power installations actually brought into operation during 1930 totalled 123,000 H.P., while there are developments of outstanding importance under active construction involving an initial installation of 805,000 H.P. and a final installed capacity of 2,013,000 H.P. The Shawinigan Water and Power Company has completed a new storage reservoir of 33 thousand million cubic feet at Taureau Rapid on the Mattawin River, an important tributary of the St. Maurice, and, to use the additional water thus provided, has completed the installation of a 25,000 H.P. unit at Grand 'Mere, while one of 30,000 H.P. is being added to the La Gabelle plant, to be ready next spring. The company has also started the construction of a 240,000 H.P. development at Rapide Blanc on the St. Maurice River.

The Alcoa Power Company is completing the main dam and also the installation of its initial plant at Chute-a-Caron on the Saguenay River; this initial plant will have an installed capacity of 260,000 H.P. in four units of 65,000 H.P. each, and will be in operation by February, 1931. The complete development of the Chute-a-Caron reach of the Saguenay River will be completed by the building of the 800,000 H.P. Shipshaw plant, which will operate under a head of 205ft., the water being supplied by a canal leading from the reservoir above Chute-a-Caron dam to the Shipshaw power-house. The principal other big development in Quebec is at Beauharnois, on the St. Lawrence, where remarkable progress is being made in the construction of a 500,000 H.P. development.

Hydro-electric construction activities were particularly active in widely separated parts of British Columbia throughout 1930, resulting in the addition of 71,000 H.P. to the province's total output from installations completed and brought into operation. In addition, other projects were actively prosecuted, involving initial installations totalling over 136,000 H.P., while other large undertakings are in immediate prospect. The British Columbia Power Corporation, through a subsidiary, the Vancouver Island Power Company, Ltd., completed and placed in operation a new unit of 18,000 H.P. in its Jordan River station. Through a second subsidiary, the Western Power Company of Canada, Ltd., a new plant was brought into operation at Ruskin, on the Stave River, with the first generating unit of 47,000 H.P. A second unit will be added when the power demand warrants, while the plant is designed for an ultimate capacity of four such units totalling 188,000 H.P. A third subsidiary, the Bridge River Power Company, Ltd., made good progress in its undertaking on the Bridge River. It is expected the initial installation of 56,000 H.P. will be ready for operation in 1932. This development is designed to be extended by stages to an ultimate capacity of 600,000 H.P.

During the late summer the West Kootenay Power and Light Company commenced construction of its fourth development on the Kootenay River. This will be known as the Corra Linn plant, the situation being about 1½ miles above the Upper Bonnington plant. The installation will comprise three 19,000 H.P units operating under a head of 53ft.

In Manitoba rapid progress was made in the construction of two large hydro-electric undertakings on the Winnipeg River. At Seven Sisters Falls, the North-Western Power Company has a development under way which will ultimately comprise an installation of six units of 37,500 H.P. At Slave Falls the city of Winnipeg is engaged in the construction of a plant designed for an ultimate capacity of eight 12,000 H.P. units, two of which will comprise the initial installation.

Obituary.

LIEUT.-COLONEL J. MITCHELL MONCRIEFF.

WIDESPREAD regret is felt at the death of Lieut.-Colonel J. Mitchell Moncrieff, C.B.E., M. Inst. C.E., who died on January 10th in London, after an illness which overtook him at the beginning of November last. Colonel Moncrieff, who was born on March 8th, 1865, was the son of the late Mr. Mitchell Moncrieff, of South Shields. After being educated privately, he served his apprenticeship at Messrs. Rennoldsons' Engineering Works, South Shields, and his pupilage as a civil engineer with the late Mr. J. Watt Sandeman, M. Inst. C.E., of Newcastle-on-Tyne, with whom he later became a partner. In that capacity he was largely responsible for the design of the famous Redheugh Bridge across the Tyne at that place, which was completed in 1901. This structure was fully described in our issue of July 9th, 1897, and was further illustrated in our issues of August 30th and September 6th, 1901. It is a steel bridge with four braced girder spans, and a peculiarity of the erection was that all the four spans were jacked over simultaneously from the positions in which they had been erected, 4ft. 6in. away from the girders of the older bridge which they superseded. Another difficulty encountered and surmounted was the fact that the older bridge carried gas and water mains, which had to be interfered with as little as possible. The whole undertaking was a fine feat of engineering, and it was possibly the greatest work of his life. The partnership was dissolved about 1906, and from that date until June, 1917, Colonel Moncrieff practised as a consulting civil engineer by himself at Newcastle-on-Tyne, during which time he carried out or was associated with many important engineering undertakings, specialising in bridges, docks, harbours, shipping facilities and riverside improvements generally. In June, 1917, he was appointed Director of Engineering Work in the Department of the C.G.M.S., Admiralty, with the rank of Lieut.-Colonel, R.E., and in 1918 he was awarded the C.B.E. (Military) for his services.

In May, 1918, by permission of the Admiralty, he resumed his practice for the purpose of designing important dock and harbour imrpovements at Falmouth. He then made London his headquarters, and subsequently, in 1919, reopened his office at Newcastle-on-Tyne, when the firm of J. Mitchell Moncrieff and Partners was founded, the other partners being Mr. John W. Goldson, M. Inst. C.E., and his own son Major Alan Moncrieff, M.C., A.M. Inst. C.E. Although that partnership was later dissolved, he carried on his practice in Westminster up to the time of his death.

Colonel Moncrieff was a member of the Institution of Civil Engineers, by which he was awarded the Telford Premium for the session 1893–1894, and for which he was sometime Examiner in Theory of Con-

struction. He was also a member of the American Society of Civil Engineers; sometime Member of Council of the North-East Coast Institution of Engineers and Shipbuilders, by which he was awarded the Engineering Gold Medal for the session 1905–1906; a member of the Association of Consulting Engineers, being Chairman of Committee in the year 1924; and the immediate Past-President of the Institution of Structural Engineers, having held office for the years 1928–1929 and 1929–1930. It was as President of that Institution that Colonel Moncrieff was invited by the Ministry of Transport to organise the British Section of the International Congress for Reinforced Concrete, which was held at Liége last September. He was also a member of the Steel Research Committee of the Department of Scientific and Industrial Research. At the time of his death he was President of the British Section of the French Society of Civil Engineers. He also served on many other committees and panels formed for scientific research, and during his career he wrote numerous engineering papers and contributed to many discussions which have been published in the "Proceedings" of various societies and in the engineering Press. When the Blackfriars Bridge disaster occurred in 1907, he was called in by Sir William Arrol and Co. to investigate and advise them regarding the cause of the accident.

CAPTAIN WM. C. BACON.

THE death of Captain Wm. C. Bacon, chairman of the Manchester Ship Canal Company, and head of the firm of Sivewright, Bacon and Co., is announced as having taken place on Monday, January 12th, at his home "Ashford," Wilmslow, at the age of seventy-seven.

Captain Bacon went to sea as a youth and obtained his first command in his early twenties. Before he attained the age of thirty he had, in partnership with the late Mr. W. J. Sivewright, founded the firm of Sivewright, Bacon and Co., shipowners and brokers, at West Hartlepool. In 1896, shortly after the opening of the Manchester Ship Canal, the firm moved its headquarters to Manchester, and Captain Bacon joined the board of the Canal Company in 1902, placing his wide experience of maritime affairs at the disposal of the company. He was appointed chairman in 1916, on the death of Mr. John K. Bythell, a position which he held up to the time of his death.

Captain Bacon had wide associations in Manchester's commercial life. He was a director of the Manchester Chamber of Commerce and of the Manchester Dry Docks Company, and his charitable interests were well known. He was a Justice of the Peace for the County of Lancaster, and in 1929 was President of the Dock and Harbour Authorities Association.

Literature.

Modern Sewage Disposal and Hygienics. By S. H. ADAMS, Assoc. M. Inst. C.E. London: E. and F. N. Spon, Ltd. 1930. Price 25s.

THIS is a book which must have taken years to compile, have entailed an immensity of research and study, and must have called for the expenditure of a vast amount of labour. It is profusely illustrated by half-tone engravings—many, if not all of them reproduced from photographs taken by the author himself—and graphs, while sixty or so tables are used to collect the matters discussed into handy form. It is, in fact—what it was evidently intended to be—a work of reference which is crammed full of data and information, and a very excellent work of reference it is. In one respect, however, it is curious. The first sixty odd pages—an eighth of the whole book—are devoted to a "Résumé of the Past." It is a record dating back to the ancient civilisations of the Egyptians, Jews, Greeks, and Romans, and intended evidently to show the march of events through the Dark Ages in which "for a thousand years there was not a man or woman that ever took a bath" to the dawn of a better state of affairs. Many cameo-like word pictures are given to show the appalling condition of affairs—in this country, and particularly in the Metropolis—until a comparatively short time ago. Much that is given—the major portion—is quite apposite and cognate to the subject in hand, but what have such things as "the degeneracy of the clergy," "the suppression of the monasteries," "the building of the Palaces of Whitehall and St. James'," "the Hanseatic League," "the licensing of hackney coaches," "the influx of Flemish weavers," "the visit of Queen Elizabeth to St. Paul's Cathedral after the defeat of the Armada," "the ducking stool, the stocks, or the brank for scolds," "the abolition of slavery in the West Indies," or "stage coaches and turnpikes"—to name a few of the subjects introduced—to do with either "Modern Sewage Disposal" or with "Hygienics"? We must confess that we have read all that is written with much interest, but we submit that a great deal of it is out of place in a publication of this character.

But to pass on to the remainder of the contents. The work is divided into ten chapters. With the first we have already dealt. The second is concerned with the Ministry of Health, its origin and functions being discussed. Chapter III. is entitled "Sewerage and River Pollution." In it we are told of the drainage of London in olden times—of the Fleet, the Tybourne, and the Wallbrook—of the early attempts at the provision of sewerage, and of the main drainage system laid down by the old Board of Works. Chapter IV. is one of the most instructive in the whole book. It treats of the "Purity of the Earth," and it discusses the means which Nature has provided for rendering sewage and other putrefactive matters innocuous. The action of bacteria and other forms of life in effecting this purification is reviewed in considerable detail, and accounts are given of the research work which has been carried out on the waters of the rivers Tees and Thames.

"Land Irrigation and the Barking Filters" forms the subject of Chapter V. In it descriptions are given of the sewage works of London, Birmingham, Paris, Berlin, and Worcester (Mass.). The Barking filters are described, and we are reminded it was at Barking that micro-organisms were first cultivated in a "contact bed," and utilised in a systematic manner for the purification of sewage.

In Chapter VI.—another excellent part of the book—which is devoted to "Bacterial Sewage Purification Processes," mention is made of the early work at Ashtead of Mr. W. D. Scott Moncrieff, who contended that the proper oxidation of the organic matter in sewage could only be obtained by separating the processes of liquefaction and oxidation, and, with that end in view, separated the processes so that the bacteria, which were essential to each, might grow in their own special environment. The Sutton bacteria beds, which attracted so much attention in the late 'nineties of last century, come in for lengthy mention, as also do the Cameron septic tank, the Hampton triple-contact beds, the slate beds at Faversham, the Ducat "Thermal" aerating filters, spraying and other types of distributors, percolating filters of different designs, the activated sludge process in its different forms and aspects, bio-aeration, mechanical aeration and air blowing, purification by dilution, &c.

The vexed question of "Sewage Sludge and its Disposal," forms the theme of Chapter VII., the methods employed at various places, including those for the extraction of grease from wool washing, as carried out at Bradford, Huddersfield, Morley, and Roubaix being reviewed in turn. In Chapter VIIA. attention is drawn to the work done in connection with the obtaining of power and light from the digestion of sludge, the work of Cameron, Kinnicult, Eddy, James, Walshaw, Pruss, Watson, Whitehead, and others being referred to in turn.

In Chapter VIII. are set out the requirements of the Ministry of Health; Chapter IX. contains a description of the Lawrence experimental station of the Massachusetts State Board of Health; while in Chapter X. is given a chronological list of Commissions, laws and events which have had a bearing on social and sanitary progress.

Altogether, it is a most comprehensive volume, which many who are engaged in designing, carrying out sewage disposal works will be glad to have in their libraries. In the non-technical parts it is in places written with refreshing quaintness, as the following extract from the "Introduction and Dedication" will show:—"And, finally, if a foreword is required, then the writer would say that, while the note-book and the camera are his own, the scissors, too, have been freely used, making his debt to old friends greater. The mere dedication of this book to them will not expunge it, but a kind thought may—that their work and his, together, will help the younger men, who have yet to plough their furrow in the same field. May these, too, know that the Great Good Spirit, who uses the bacteria of the sewage to feed the sweet lavender of Sutton and the vines of Achères, cares equally for his creature—man—and be encouraged."

The Ancient Bridges of South England. By E. JERVOISE, Assoc. M. Inst. C.E., with an introduction by C. R. PEERS, Chief Inspector of Ancient Monuments. London: The Architectural Press. Price 5s. 6d.

THE author of this charming little volume has spent the last four years and more in making—on behalf of the Society for the Protection of Ancient Buildings—a survey of the ancient bridges of England. His work is not yet completed, but, as so little has been written about ancient bridges, it was felt that the results so far achieved in his investigations, should be published, and the present book is the outcome. Its avowed intention is to enlist public interest in the preservation of our old bridges, and it should, we think, go some long way towards doing so. The author's method was to follow the course of various rivers and streams from their sources to their mouths, noting each bridge as he came across it, photographing a great many of them, and giving historical notes about past and existing bridges wherever possible. These notes, it may be said, are, many of them, of great interest, and we must confess to feeling regret that, in not a few instances, they were not more full than they are. Much research has, however, evidently been made in order to afford the information that is given, and, doubtless, more data are not available. The *Itinerary* of Leland, early county histories, the *Victoria County History*, the Close and Patent Rolls and the publications of various Archæological and Record Societies, have been consulted on the subject and are freely quoted.

The work is divided into eight chapters. The first deals with the Thames and its Bridges; the second with the Southern Tributaries of the Thames; the third with the Rivers of Kent; the fourth with those of Sussex; the fifth, sixth, seventh and eighth with those of Hampshire and South Wiltshire; Dorset; Central Somerset; and Exmoor and the Bristol Avon, respectively. The volume is illustrated with nearly eighty half-tone reproductions of photographs—the large majority taken by the author himself—of some of the bridges mentioned in the text. Many of the views are artistic gems, exquisitely reproduced and beautifully printed. It is to be hoped that the author, when he has completed his survey, will give us another volume, or other volumes, containing an account of his further discoveries.

SHORT NOTICES.

A Practical Treatise on Single and Multi-stage Centrifugal Pumps. By Raymond Defeld. Translated by C. W. Olliver. London: Chapman and Hall, Ltd. 1930. 21s.—Technical books written by continental writers are usually found to treat more fully of the theoretical side than is considered necessary in this country. Monsieur Defeld can at least urge that in this book he has used no more mathematics than is essential to give a true account of the theory of the centrifugal pump. He has plotted many of the equations in the form of abscissæ in order to make the results more rapidly accessible to the designer. In the earlier chapters the design of impellers, diffusers, and guide vanes is dealt with fully, and, in later chapters, the more practical details in the design of special pumps and the methods of balancing axial thrust adopted by various makers are mentioned. There is a chapter on testing in which the author does not enter too deeply into the theory underlying the use of the various measuring devices employed, and a chapter on suction lift which refers in part to experiments carried out by the author for his firm, the Ateliers de Construction Electriques de Charleroi. The book is fully illustrated by many photographs and diagrams; but it seems to us hardly worth while to reproduce photographs of priming cocks and funnels, air cocks, or ordinary clock type gauges. The book, it is stated in the preface, has been written in the hope that it will be of use to both engineers and students, but we venture to think that in attempting so much Monsieur Defeld has written a book that will be considered hardly satisfactory by either. Owing to the fact that the book is translated from the French, trouble has arisen with regard to the units employed; we doubt if Mr. Olliver, the translator, was wise to leave the greater number of the dimensions in metric units. The use of these unfamiliar units will impress upon the student a feeling of insecurity, while for use in this country all the abscissæ must be re-drawn.

BOOKS RECEIVED.

"*Gas Journal*" *Calendar and Directory*, 1931. London: Walter King, Ltd., 11, Bolt-court, E.C. 4.

The Motor Ship Reference Book, 1931. London: The Temple Press, Ltd., 5 to 15, Rosebery-avenue, E.C. 1. Price 5s. net.

Ice and Cold Storage Trades Directory, 1931. London: Iliffe and Sons, Ltd., Dorset House, Tudor-street, E.C. 4. Price 10s. 6d. net.

Rationalisation. By J. A. Bowie, M.A. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 1s. net.

Francis J. Blight, Publisher. A Biographical Sketch by G. Hawker. London: Elliot Stock, 7, Paternoster-row, E.C. 4. Price 10s. 6d. net.

The Manufacture of Artificial Silk (Rayon). By E. Wheeler. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 12s. 6d. net.

Jahrbuch der Hafenbautechnischen Gesellschaft. Vol. II., 1928–1929. Berlin: V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 45 marks net.

Mitteilungen aus den Forschungsanstalten. Vol. II., November, 1930. Berlin: V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 2·50 marks.

The Concrete Year Book, 1931. Edited by O. Faber and H. L. Childe. London: Concrete Publications, Ltd., 20, Dartmouth-street, S.W. 1. Price 3s. 6d. net.

The Official Directory of the British Chemical Plant Manufacturers' Association, 1931. London: The British Chemical Plant Manufacturers' Association, 166, Piccadilly, W. 1.

Studies on Two-stage Sludge Digestion, 1928–29. *Bulletin No. 29 of the Illinois State Water Survey.* Urbana, Illinois: Department of Registration and Education, State Water Survey Division.

Water Pollution Research, Summary of Current Literature. Volume 4. No. 1, *Abstracts* 1–138. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 3d. net.

The Propagation of Combustion in Powdered Coal. By H. E. Newall and F. S. Sinnatt. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 3d. net.

The South and East African Year Book and Guide, 1931. Edited by A. Samler Brown and G. Gordon Brown. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price 2s. 6d. net.

Dreiundzwanzigste Berichtfolge des Kohlenstaubausschusses des Reichskohlenrates: Das Schrifttum über Kohlenstaub. By D. Knabner. Berlin: V.D.I. Verlag, G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 6 marks net.

Physical and Optical Societies' Exhibition.

No. II. (*conclusion*).*

THE chief exhibit of Evershed and Vignoles, Ltd., was a working model of the Midworth system for distant control recently installed by the L.M.S. and L. and N.E. railways at Altrincham. With this equipment, which is entirely British, the sub-station at Timperley, which actually supplies the power to the lines, is completely controlled from the main sub-station at Old Trafford. At the Old Trafford sub-station there is an engineer in charge, and by means of the Midworth distant repeater system, which operates in conjunction with the switchgear plant installed by the British Thomson-Houston Company, Ltd., he can start and stop the three 1500 kW rotary converter sets in the Timperley sub-station, vary their output, open or close the switches that connect them to the track, and operate circuit breakers when required. The carrying out of each operation is confirmed on a main dial at the control station, and other dials by the side of the operating engineer show the voltage load, &c., at the distant sub-station, so that he has a complete picture of the working of the distant plant.

The equipment, which is shown diagrammatically in Fig. 14, consists of a main control transmitter, with its associated equipment at the main sub-station —Old Trafford—and the selector receiver with its associated equipment at the unattended sub-station —Timperley. The auxiliary equipment at the control station consists of a confirming receiver, which shows that the operations have been carried out; control buttons for operating the switches and for raising and lowering the voltage; a circuit breaker indicator, showing whether selected circuit breakers are "open" or "closed," together with an alarm, which sounds when any circuit breaker is opened by a fault; machine ammeters, a bus-bar voltmeter, and a machine voltmeter, which shows, by selection, the voltage on one of the three D.C. sets.

At the controlled sub-station the equipment consists of the main selector receiver, which selects the various operations to be performed, the confirming transmitter, transmitting ammeters and voltmeters, and the circuit breakers and switches for operating the machines, which are shown on an illuminated diagram. The single lines in the illustration indicate channels and may represent two or more wires, according to particular requirements. The operation of the Midworth equipment for distant metering and control is unaffected by changes in the voltage of the supply, or by changes in the resistance of the pilot lines. The control transmitter is provided with a lock switch having two positions, "locked" and "free," and in the "free" position the operating handle can be moved to any position on the dial, but the control buttons are not made alive and cannot, therefore, be operated until the dial is locked in the position appropriate to the operation selected, such, for instance, as No. 7, which sets the circuits of set No. 2 machine for "start" and "stop." When, on the other hand, the switch is in the "locked" position and the control circuits are alive, it is not only impossible to alter the setting of the control transmitter, but the selector receiver is also locked, and its position cannot, in any circumstances, be changed. Another important feature is the provision of a confirming transmitter at the sub-station operating a confirming receiver at the control station, so that the operator at the control station has, at all times, clear visual indication of the response of the distant receiver selector. Other characteristics of the system are that it is prompt in action and special apparatus and wiring are reduced to a minimum. All the apparatus is of very robust construction.

The operation of the equipment may, perhaps, be best understood by considering that the unattended sub-station is entirely shut down, and that it is desired to put it into operation. The first operation may be to discover whether the track circuit breakers are "open" or "closed," which is carried out by setting the lock switch of the control transmitter to the "free" position and traversing the index successively through positions 13, 14, 15 and 16, when the circuit breaker indicator will show which breakers are "open" or "closed." Should any be "open," they can be closed by setting the control transmitter to the appropriate position—13, 14, 15 or 16, as the case may be—moving the lock switch to the "locked" position, and operating the control buttons. As each circuit breaker is closed, the operation is shown on the circuit breaker indicator. The next operation may be to see whether the manually operated E.H.T. feeder switches, which are normally left closed, are actually closed. This can be carried out quickly by setting the control transmitter to the "free" position and traversing the index through positions 1, 2 and 3. If the switches prove to be closed, any machine—say, No. 1—may be started up by moving the index at the control transmitter to the appropriate position—say, No. 4—and by waiting until the confirming receiver shows that the operation has been duly carried out and then setting the lock switch to the "locked" position, and operating the "start" control button. By the rise of volts, the machine voltmeter will show that the machine is running up to speed. Before it is put on load, the voltage is raised or lowered to correspond with the bus-bar voltage through position 5, and when the voltage is at the required value, the machine can be put on load by closing the appropriate D.C circuit breaker No. 1 through position No. 6. The load on the machine is then indicated on the appropriate ammeter. Similar operations may be carried out for the other machines as the conditions of load dictate.

If at any time any circuit breaker should trip on a fault, or for any other reason other than operation through the control transmitter, the circuit breaker alarm is caused to sound and continues to do so until the operator at the power station re-closes the particular breaker, or acknowledges that conditions are not suitable for re-closing, by making the appropriate setting and pressing the "open" button. This applies in everything with the exception of the E.H.T. switches, which are operated by hand, and cannot, therefore, be re-set directly from the control position. Arrangements are made to silence the alarm when it is caused to sound by the tripping of the E.H.T. switches by the provision of a circuit breaker alarm trip. While, however, this alarm trip will silence the alarm for a particular trip, it will sound again in the event of any other breaker being opened, or in the event of a second opening of the same breaker after it has been re-set. The breaker which has come out may be quickly found by traversing the index of the control transmitter across the dial, while observing the circuit breaker indicator as the various positions are passed. The information may also be obtained from the machine ammeters and voltmeters. If, for instance, the three machines are on load when the circuit breaker alarm sounds, and machine ammeter No. 1 is showing zero, while the machine voltmeter remains at 1500 volts for each of the sets, it is clear that machine No. 1 has lost its load, but is still running light. The trouble cannot be on the H.T. side, and it is clear that the breaker that has opened is that between set No. 1 and the bus-bar. Everything, with the exception of the manually operated E.H.T. switches, can be re-set from the control position in the event of being tripped.

One of the Cambridge Instrument Company's exhibits was a new thermometer element, which may be used in connection with the firm's electrical distance

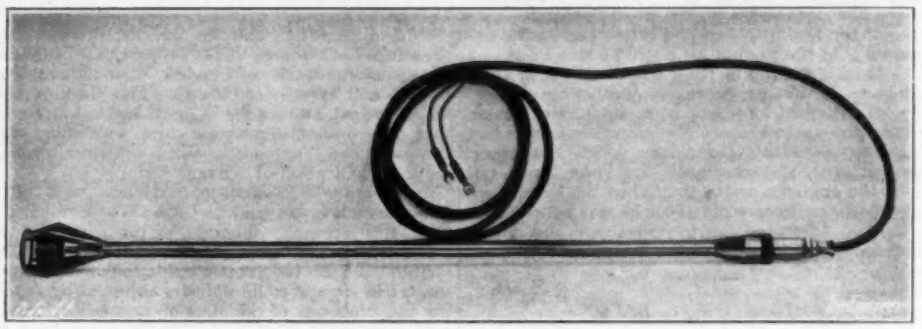


FIG. 15—QUICK-ACTING THERMOMETER—CAMBRIDGE

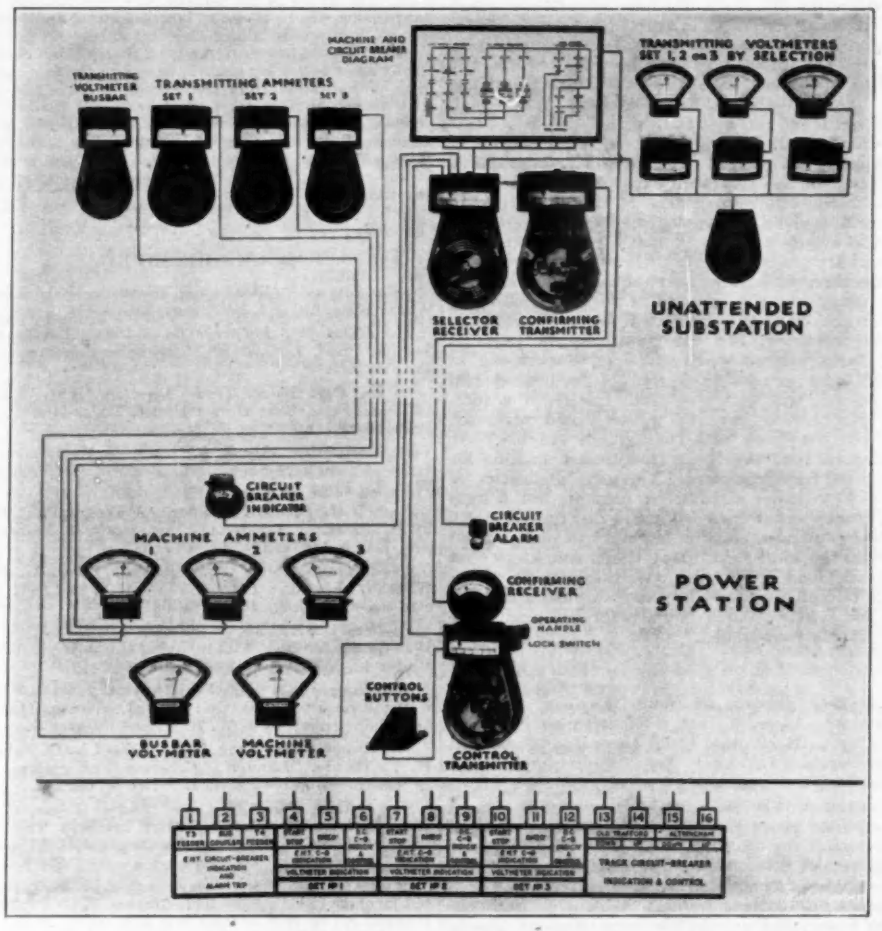


FIG. 14—MIDWORTH DISTANT CONTROL SYSTEM—EVERSHED

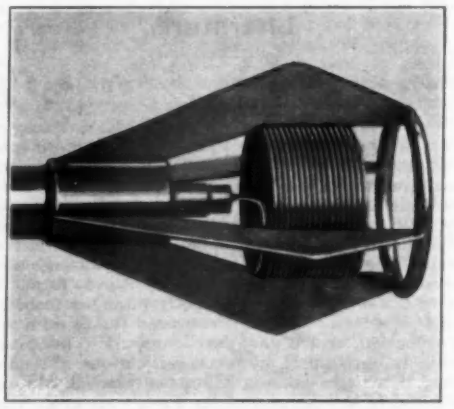


FIG. 16—THERMOMETER ELEMENT

* No. I. appeared January 9th.

thermometer outfits. As is well known, with these outfits the temperatures at a large number of scattered points may be read on a single indicator with an accuracy which is independent of the distance separating the points from the indicator. The principle depends on the variation with tempeature of the electrical resistance of a platinum wire. The thermometer element comprises an encased coil of platinum wire provided with terminals. The resistance of the element at different temperatures is measured on a galvanometer, which embodies a modification of the Wheatstone bridge, the variable resistance being compared with other resistances which do not change with temperature, and their value is adjusted so that the bridge is balanced at the commencing temperature of the range of the galvanometer. Any increase in the temperature of the element causes the galvanometer pointer to move over a calibrated scale. All sensitive parts of the indicator are protected from dust, moisture, or fumes by a substantial metal case. Single-point or multi-point indicators are made, the latter being arranged for either 6, 12 or 18 points, and a multi-way switch enables any thermometer to be put in circuit at will. Recording outfits are also made. The new quick-reading thermometer element, which can be used in connection with these outfits, rapidly responds to temperature changes, steady readings of any temperature within the range of the indicator being obtained in about 4 seconds after the insertion of the thermometer, whilst small temperature changes are registered instantly. The range of the indicator scale may be reduced to about 20 deg. Fah., giving very open graduations around, say, the freezing point, or any other selected temperature. These thermometer elements can be employed in conjunction with a single-wall pattern indicator,

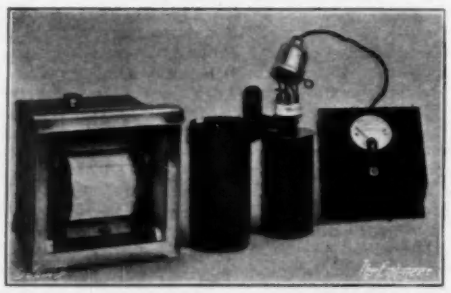


FIG. 19—HUMIDITY RECORDER—CAMBRIDGE

or with a portable indicator, for any application calling instantaneous readings of changes in temperature. A typical form of the new quick-acting thermometer is shown in Fig. 15, and an enlarged view of the platinum coil in Fig. 16, but it should be mentioned that the method of mounting the thermometer element is varied, in accordance with the conditions under which it is to be used.

The Cambridge portable vibrograph—shown in Figs. 17 and 18—is designed for making spot tests of high-period vibrations, and can be applied to a vibrating surface in any horizontal or vertical position. The weight of the instrument is about 8 lb., whilst that of the carrying case is about 5 lb. Fig. 17 shows the complete instrument with connecting leads, and Fig. 18 the instrument packed in its case ready for carrying about. The toe B projecting from the base of the instrument, is pressed against the surface at the spot where it is desired to measure the vibrations, and these vibrations are transmitted through a series of levers to a fine stylus S, moving over a strip of cellulioid film C, wrapped around the drum D, the levers giving a mechanical magnification of 7 : 1. A celluloid strip, 35 mm. wide, is moved past the stylus by means of clockwork mechanism, the speed of which can be varied from 3 mm. to 20 mm. per second by means of the switch U. The pressure of the stylus on the film can be adjusted by means of the milled head P. An excentric rod, situated below the spring carrying the stylus, can be rotated by means of the lever J, so as to raise the stylus out of contact with the film, thus protecting the pen of the stylus when the instrument is not in use, or is being moved, or when the film is renewed. An independent time record is traced on the inner surface of the strip by a second stylus enclosed within the drum D and operating through the gap G at the centre of the drum. This time-marking stylus is operated by an electro-magnetic device E, controlled from a separate contact-breaking clock, arranged to make-and-break the electric circuit at regular intervals of .0·1 second. Four-way connecting leads pass through the removable handle H, and serve to connect the apparatus to a battery, differently coloured tangs being provided at the ends of the leads to avoid errors in connecting up. A push-button switch F is fitted on the handle, by means of which the clockwork driving the film, and the time-marking mechanism, can both be simultaneously set in motion and stopped. The clockwork can also be started by depressing the push-button T on the top of the instrument when it is only desired to test the mechanism. In taking actual records, however, the switch F must be used, as any pressure on T would affect the record. A cap can be placed over the toe B to prevent accidental movement of the mechaniism when the instrument is not in use.

The records obtained with the instrument are of small dimensions, and are permanent. The lines forming the records are clearly defined, and will bear considerable magnification, so that the vibrations can be measured with great accuracy. The records can be removed from the instrument and examined immediately they are made, without chemical treatment or any lighting precautions, and they can be viewed by means of a microscope, or direct enlargements can be obtained by photographic methods, by a *camera lucida*, or by projection upon a screen.

The Cambridge humidity recorder, shown in Fig. 19, was originally developed for determining the humidity of paper when on the rolls of the calendering machine, and it offers the important advantage that the humidity records are not affected by changes in temperature over a wide range. The apparatus is thus suitable for use in a wide variety of applications. Since it will work efficiently at temperatures below zero, it is paticularly useful for recording variations in the humidity of freezing chambers, refrigerating rooms and cold stores. An interesting application is that of the recording of the humidity in the fan chamber of large pipe organs, in cathedrals, churches, cinemas and public halls.

The action of the instrument depends on the fact that goldbeater's skin varies in length with the hygrometric state of the surrounding atmosphere, these variations being accurately repeatable if the skin is maintained under certain conditions of load. A strip of goldbeater's skin, held under tension, is exposed to the air in the position where it is desired to measure the humidity. The ends of the strip are attached to a flat spring at one end of a fixed frame, and the strip is passed over a roller at the other end of the frame, the roller being connected to an electrical micrometer, by means of which the movements of the goldbeater's skin are electrically recorded. The electrical micrometer, the design of which is due to Dr. G. A. Shakespear, of Birmingham University, comprises four identical spirals of platinum wire arranged to form the four arms of a Wheatstone bridge, through which a constant current is passed. When the length of the goldbeater's skin strip alters, owing to the changes in humidity, two of the spirals forming one pair of arms in the Wheatstone bridge are extended and the other two, forming the opposite arms, are compressed. The extension and compression causes changes in the resistance of the respective coils, thereby throwing the Wheatstone bridge out of balance, and causing a deflection of the galvanometer pointer. The galvanometer forms a moving system of a special model thread recorder, which is a simplified form of the well-known Cambridge thread recorder, supplied for measurements of temperature, CO_2, &c., and is calibrated to read directly in terms of relative humidity, the usual range beng 30 to 100 per cent. The recorder can be installed some distance away from the position at which the humidity measurements are being taken. Current for the Wheatstone bridge circuit is supplied from a dry cell or accumulator, and the leads from the electrical micrometer and from the battery are connected to an ammeter box. A milliammeter, mounted on the front of this box, indicates whether the current in the Wheatstone bridge is steady, and, by adjusting a rheostat contained in the box, compensation is made for variations in the battery voltage. The illustration—Fig. 19—shows the complete apparatus, but it should be mentioned that the housing containing the goldbeater's skin has been recently modified in design. If it is desired only to take readings of the relative humidity from time to time, and continuous records are not required, an indicator can be used instead of the recorder.

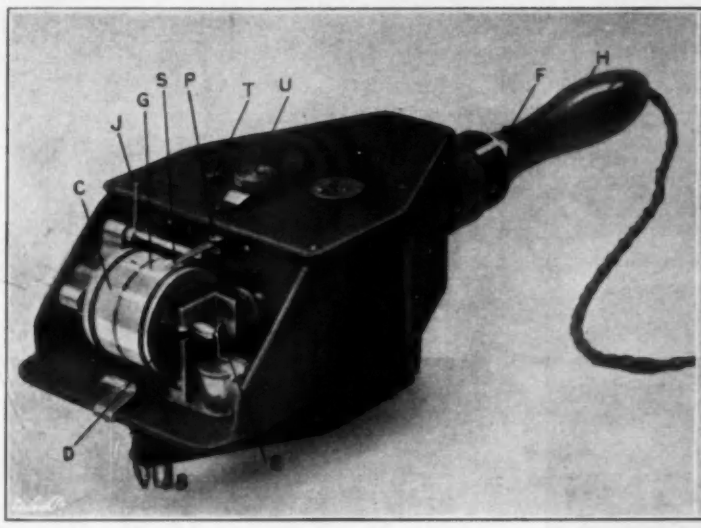


FIG. 17—PORTABLE VIBROGRAPH—CAMBRIDGE

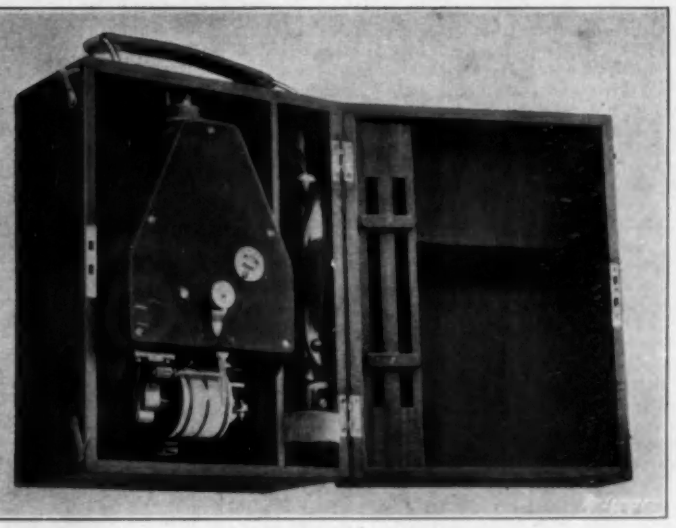


FIG. 18—VIBROGRAPH IN CASE—CAMBRIDGE

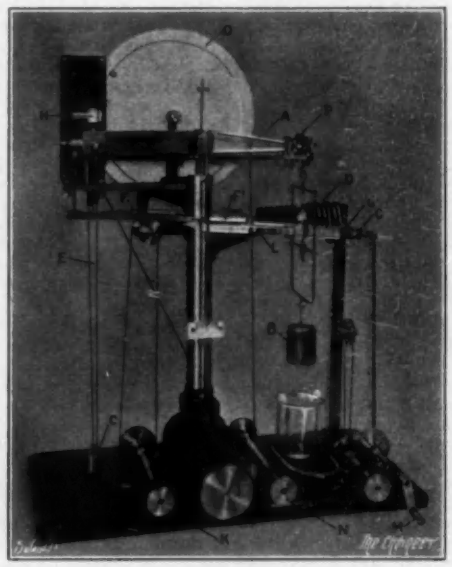


FIG. 20—SPECIFIC GRAVITY TESTER—AVERY

The most original exhibit on the stand of W. and T. Avery, Ltd., was the precision liquid specific gravity tester, shown in Fig. 20, which has been designed for determining the specific gravity of liquids in cases in which extreme accuracy is required, combined with rapidity of operation. An accuracy of 0·0001 is guaranteed in ordinary use, but in the hands of a skilled operator a much greater degree of accuracy is possible.

The instrument consists of a constant load two-knife-edge beam A, fitted with a special relieving device and permitting of the weighing in the liquid under examination of a gravity bulb B. A weight

C is supplied which exactly counterbalances the loss of weight of the bulb in distilled water at a standard temperature, whilst for use with liquids heavier than water additional weights D are supplied corresponding to multiples of 0·01 specific gravity. Specific gravity values between zero and 0·0099 are indicated by means of a special type of chainometric balance E. A weight-selecting device F and depositing device G are embodied in the apparatus. The exact specific gravity is read in clearly printed figures at a window H. The weight-depositing device G is brought into play after the weight-selection portion of the device has been manually operated by means of the knurled knob K. On turning this knob, a sliding frame F^1, carrying weights corresponding to specific gravity values 0·01, 0·02 to 0·09, is moved successively over a forked weight-supporting piece on the suspension member from which the density bulb is hung. When any weight is immediately over the supporting piece a ball-click L, actuated by a spring, holds it in position until, by slightly increasing the pressure, the weight-carrying frame slides into the next depositing position.

To deposit a weight, the handle M is turned, causing the lowering of the weight-carrying rack G^1 and the shockless-deposition of the particular weight which has been selected. The selection portion of the apparatus is connected to a vertically sliding figure-carrying strip, adapted to expose figures corresponding to the specific gravity represented by the weights at the left-hand side of the dial window H. When a weight has been selected and positioned ready for deposition, the specific gravity value corresponding to the weight is shown automatically at the dial window, with the addition of the unit figure. In the instrument illustrated no provision is made for showing figures representing tenths of a unit of specific gravity, as the balance is intended for making extremely accurate determinations of the gravity of liquids varying in density from 1·0000 to 1·10000.

The chainometric device is operated by the knurled knob N, which produces the effect of adding weights corresponding to densities of 0·0001 to 0·0099 to the load by removing a portion of chain from the left-hand end of the scale-beam. The density figures are inscribed on the periphery of the circular disc O, on which the chain is wound. These figures appear at the right-hand portion of the window, and complete the indication of specific gravity by their contiguity to the figures of higher denomination. The instrument can be operated very rapidly. It is supplied with an arrangement P for "tenths" weights, so that it can be used for ascertaining the density of the heaviest liquids known. By a small modification in construction, the instrument can be adapted to deal with liquids lighter than water, to an equal degree of precision. The parts are operated by means of fine steel straps, which give a very smooth and reliable movement.

The Foster Instrument Company was showing a high-resistance indicator for use with electrical pyrometers. Great stress is often laid on the desirability of high resistance in instruments of this kind, for it is well known that the effect on the readings of variations in external resistance is reduced as the internal resistance is increased. On the other hand, each increase in internal resistance decreases the deflecting forces available to overcome friction at the pivots, and the instrument becomes more delicate and more liable to de-arrangement. The obvious course would appear to be only to accept the disadvantages of high resistance when considerable variations of the resistance of the external circuit are likely to be met with. The quality of a pyrometer indicator, however, is often judged by its resistance, and the tendency has, perhaps, been accentuated by manufacturers who desire to make only one type of instrument and who must, therefore, adopt a high resistance in order to meet these cases in which such an instrument is desirable.

The Foster Instrument Company has long supplied low-resistance instruments for use where variations in the external circuit are not possible under normal conditions, with the result that it has been able to provide an indicator with a flat scale and a horizontal axis of movement, just like an ammeter of the ordinary switchboard pattern and practically as robust. Feeling, however, that this consistent advocacy of proportioning the resistance to the requirements of the service may have produced the impression that the manufacture of high-resistance instruments presents technical difficulties, the company has produced an instrument of extra high resistance. The company has always supplied high-resistance instruments when required, but the new instrument has a very high resistance. It is calibrated for use with a normal base metal thermo-couple, and its resistance is no less than 4250 ohms, whilst, in the pyrometry industry, a resistance of 500 ohms is considered high for a double-pivoted movement. With an instrument of this kind, many measurements previously calling for the use of a potentiometer can now be made with a direct reading indicator and an external circuit resistance of over 4 ohms will only cause a drop in reading of one-tenth of 1 per cent., with the result that the indicator may be used for different lengths of thermo-couple and cable without incurring the risk of an error of significant amount.

It is not sufficient, the makers point out, only to provide high resistance, for the resistance will increase when the instrument is used under hot conditions, and this increase will cause serious errors unless the proportion of copper is small compared with the "ballast" resistance. Since the copper moving coil is the only part of the instrument which can provide the deflecting force, there is a strong temptation to make the proportion of copper large, and whilst great stress is often laid on the high resistance, little is said about temperature coefficient. An instrument may have a total resistance of as high as 750 ohms, whilst the copper coil may have a resistance of 375 ohms. Such an instrument will read low by two-tenths per cent. for each degree Centigrade above the temperature at which it was originally calibrated. If, for instance, the instrument were calibrated at a temperature of 16 deg. Cent. and then used at 26 deg. Cent., it would read low by 2 per cent. and a true temperature of 1000 deg. Cent. would be shown as 980 deg. Cent.

In the Foster instrument, shown in the upper part of Fig. 21, the copper resistance is not quite 200 ohms, or less than one-twentieth of the total resistance, so that its temperature coefficient per degree Centigrade is only two-hundredths of 1 per cent., and the

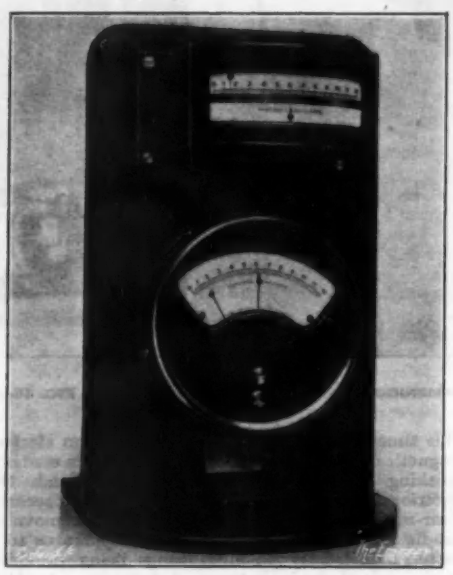


FIG. 21—PYROMETER INDICATORS—FOSTER

change from 16 to 26 deg. will only cause it to read low by two-tenths per cent., a true temperature of 1000 deg. Cent. appearing as 998 deg. Cent. By using such a low proportion of copper, difficulties were, naturally, experienced in the way of providing sufficient deflecting force to overcome pivot friction, but they were met by using the firm's well-known "Resilia" spring mounting, which permits of the use of very finely pointed pivots without risk of damage. The question of damping also arises. When a large amount of copper is used in a high-resistance instrument the weight and moment of inertia of the moving coil are high and the movement is poorly damped, with the result that the pointer of such an instrument will swing many times before it comes to rest. For practical work the pointer should come to rest smoothly at the final reading with, perhaps, one small overswing, and the instrument on view showed how well this requirement has been met.

In order to demonstrate the practical advantages of a properly designed low-resistance indicator, where the use of such an instrument is permissible, a "unit class" circular indicator was exhibited below the high-resistance edge-wise instrument, as shown in Fig. 21, both being calibrated for the same type of base metal thermo-couple and connected to their circuits by the same switch. The demonstration showed that the advantages claimed as regards ease of reading the flat scale with a horizontal axis of the pointer were substantiated, that the movement was dead-beat and that the low-resistance instrument was the more robust. In instruments for ordinary electrical measurements, the case is made of magnetic material in order to shield the internal permanent magnet from the effects of external currents, or masses of iron or steel, or a neighbouring unshielded instrument. In the case of instruments used for electrical pyrometry, however, shielding is not always adopted; but the shielding of both the indicators shown in Fig. 21 is twice as effective as the minimum laid down by the British Engineering Standards for electrical measuring instruments.

The most original exhibit of Kelvin Bottomley and Baird, Ltd., was the Pneumercator distance specific gravity gauge for indicating the specific gravity of liquid in a tank at a distance. The ordinary Pneumercator tank gauge, which is well known to our readers, is operated by the pressure due to the height of liquid above the balance chamber zero edge, the pressure being given by the height of liquid multiplied by its specific gravity. Two Pneumercator balance chambers are fixed at a definite vertical distance apart, as shown in Fig. 22, the lower one being coupled to the bottom of the indicating gauge, whilst the other is connected so as to act against the first chamber. Obviously, the gauge-indicating liquid column will be operated by a fixed height of liquid, *i.e.*, the distance between the two balance chamber edges, so that the gauge scale can be graduated in terms of specific gravity of the liquid surrounding the balance chambers. The distance Pneumercator gauge will always give the specific gravity of the liquid in the tank, irrespective of whether the tank is vented, or under pressure or vacuum. A double-member geared valve is now fitted to the gauges in place of separate valves and allows the tubing to each balance chamber to be blown down by means of a hand air pump, and then be connected to the bottom and top gauge respectively. The fixed distance between the zero edges or weirs

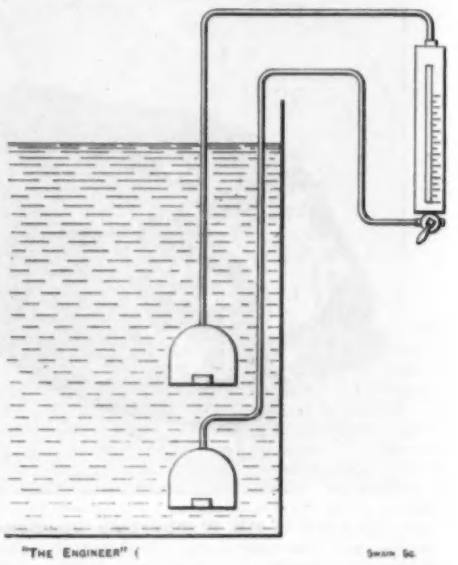


FIG. 22—DISTANCE SPECIFIC GRAVITY GAUGE—KELVIN

of the balance chambers is adjusted to suit the range of specific gravity required and to put a limit on the necessary length of the gauge.

Research engineers and others interested in laboratory standard apparatus were well catered for by the Marconi Company. The refinements necessitated by the accuracy required in short-wave transmitters and receivers have been responsible for the development of entirely new measuring instruments, which were shown for the first time. The exhibits of this nature consisted of a screened capacity bridge, an impedance bridge, a variable standard condenser, a transmission measuring set, a cathode ray oscillograph, a tone generator and a valve voltmeter, whilst commercial developments in wireless were represented by a Marconi short-wave direction finder, a constant frequency drive for broadcast transmitters, portable picture apparatus, and a precision wavemeter for 10 m. to 100 m. wavelengths. The Marconi screened capacity bridge has been designed to meet the requirements of those whose work entails the accurate measurements of capacities and conductance, and it may be used to carry out numerous tests over a frequency range of from 700 to 1400 p.p.s. Balance is obtained by the null method, and when an oscillator of reasonably pure wave form is used it is possible to obtain a perfect balance. The impedance bridge provides a portable and convenient means of accurately measuring inductance and capacity values, such as are generally employed in wireless practice, and an accuracy of from $\frac{1}{2}$ to 1 per cent. is obtainable.

Limitations of space will not allow us to describe all the Marconi exhibits in detail, but attention may be called to the portable picture transmitting apparatus and one or two other wireless exhibits. Transmitting and receiving equipment of a portable nature has been produced for air and military authorities for the exchange of rough sketches, such as maps, weather charts, or written messages, between air and ground stations, or between two observation posts on the ground. The message to be transmitted is written or drawn on a specially backed paper, which is wrapped round a fixed drum in the transmitter, and is traversed by a moving stylus. At the receiving end a damped paper around a drum is also traversed by a stylus and a resulting chemical action produces a facsimile of the transmitted message. The transmitter and receiver are fitted with a specially designed unit to ensure that they are perfectly synchronised. The apparatus is not capable of dealing with half-tones, its purpose being solely to convey intelligence in the form of maps, handwriting or sketches.

In the constant frequency drive for broadcast transmitters crystal-controlled and inductance-capacity circuits are employed, which can be tuned to drive the transmitter at any of the wavelengths required by the user. The drive which was exhibited is designed for a final fixed wavelength of between 200 m. and 250 m. The wavelength of the crystal and of the inductance-capacity circuits is twice that of the final wavelength, and the three crystals pro-

vided are selected to be of the required frequency. Normally, one of these crystals is in use and the other two serve as stand-by crystals. Thermostatic control by means of a bi-metal thermostat relay and a bank of heater lamps is provided to maintain the drive circuits at a constant temperature.

The continued increase in the number of wireless transmitting stations, especially of those operating on frequencies of between 30,000 and 3000 kilocycles, has resulted in transmitters being specially designed to maintain over a long period of time and within very narrow limits the frequency to which they are adjusted. This, in turn, has led to the demand for extremely accurate frequency measurements, and to meet the demand for a frequency meter suitable for commercial purposes the Marconi Company has designed the instrument—shown in Fig. 23—with a

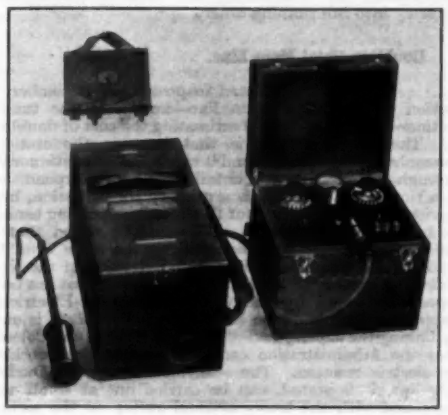


FIG. 23—WAVE METER—MARCONI

range of 10 m. to 100 m. and which combines the features of portability, high accuracy, small temperature coefficient, great mechanical rigidity and easy operation. It consists of a condenser-inductance circuit, which can be coupled to a transmitting circuit by means of an aperiodic coupling coil. Coupled inductively to the main condenser-inductance circuit is a second aperiodic circuit, which is connected to a detector valve. In designing this meter a great deal of attention has been paid to obtaining the highest degree of accuracy commensurate with portability and ease of handling. The tuning condenser is provided with a carefully-engraved vernier scale of 110 divisions, and the values of the inductances have been so chosen that an accuracy per vernier division of not less than 1 in 6000 is obtained, the actual figure depending, of course, upon the value of the inductance and capacity in the circuit.

Some exhibits of the Westinghouse Brake and Saxby Signal Company were designed to illustrate a number of little-known examples of the use of Westinghouse metal rectifiers. Typical examples of moving coil A.C. instruments in which the Westinghouse metal rectifier is assembled into the same case with a D.C. moving coil type movement, and including ammeters and milliammeters reading to 0·1 Ma. full scale, and voltmeters reading down to 50 Mv. full scale, were on view. As the power consumption is very small—1 milliwatt at full scale for an average type instrument, or 0·1 milliwatt for specially low-consumption laboratory types—it is possible to use these meters for making measurements which at one time could only be made by means of thermionic valve voltmeters. Up to 2000 cycles the frequency error is negligible, and is in the neighbourhood of 2 per cent., or less at 5000 cycles. Measurements can, therefore, be conveniently made with a fair degree of accuracy on L.F. amplifier and telephone apparatus, while the modulation of wireless transmitters, &c., can also be checked. The instruments, naturally, possesses all the advantages of moving coil instruments as regards robustness, immunity from damage owing to overload, and portability, while the short-time period of oscillation and good damping enable quick readings to be taken and rapidly changing quantities to be followed. Indicating milliammeters and voltmeters of the switchboard and laboratory patterns were shown, together with a graphic recording milliammeter suitable for recording the output from an amplifier. The instruments exhibited were lent by Ernest Turner, Ltd., Everett Edgcumbe and Co., Ltd., and the Cambridge Instrument Company, Ltd., who manufacture instruments of this type, incorporating Westinghouse metal rectifiers.

In the research section of the Exhibition, the British Thomson-Houston Company was exhibiting experimental apparatus designed by the company's engineering laboratory staff, and among this apparatus was a noise analyser, as used in the B.T.H. works. By means of this apparatus, which was shown in operation, the sound produced by a running machine can be analysed into its component frequencies, the noise to be analysed, which must be of a periodic nature, being picked up by a microphone and amplified. The amplified current is used to modulate a carrier frequency variable between 11,000 and 16,000 cycles per second, and the modulated current, containing components, among others, equal to the sum of the carrier frequency, and each component of the noise is supplied to a resonant circuit tuned to 16,000 cycles per second. The amplitude of the component is deduced from the amplitude of response, and the frequency from the corresponding carrier frequency. The 16,000 cycle resonant system consists of a steel bar in longitudinal oscillation and is driven electrostatically. Whilst the apparatus is primarily intended for the analysis of machine noises, it may also be used for the analysis of electrical wave forms. Another exhibit was a compressed gas condenser, suitable for a pressure of 33,000 volts, having a capacity of 500 cm. and intended for use in bridge work for measuring small phase angles, its special features being small size and stainless steel construction to prevent corrosion.

A fascinating demonstration was given of the properties of the B.T.H. cæsium photo-electric cell, which has been manufactured in quantities under factory conditions for the last two years. A cell is connected through a "thyraton" amplifier—see Fig. 24—which magnifies the cell current over 100,000 times in one stage, and the current is made to drive a D.C. motor, the speed of which is indicated aurally by the pitch of a note from a loud speaker. As shown in the diagram, the motor is fitted with a slotted

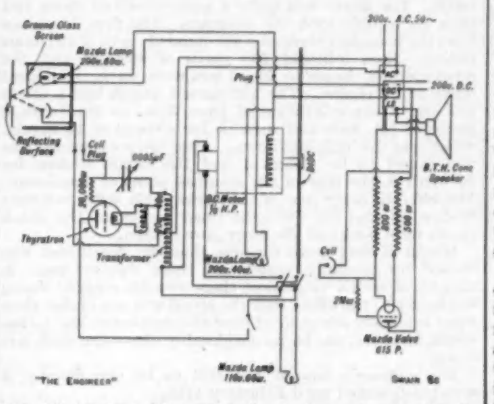


FIG. 24—PHOTO-ELECTRIC CELL APPARATUS—B.T.H.

disc, which interrupts the light from a lamp acting on a second cell, the response of this cell being amplified by a valve to operate a B.T.H. cone loud speaker. Hence, for each value of light received by the cell controlling the "thyratron," a definite note is given out by the loud speaker. The comparative sensitivity of the cell to different colours can readily be observed by the varying speed of the motor, and the consequent pitch of the note the effect of supplying a red light to the cell being to make the motor run at high speed. A striking demonstration of the sensitiveness of the cell to infra-red can be obtained by shining a lamp alternately through transparent and opaque screens, when the interesting fact is revealed that to the cell, the latter is decidedly transparent, and the former opaque; or, in other words, the effects of these screens on the cell is exactly opposite to their effects on the human eye. Another interesting experiment is that of lighting an electric lamp with a match. An unlighted lamp is connected to the amplifier output terminals and placed near the photo-electric cell. When a lighted match is held near the lamp, the cell is excited and, in turn, the lamp lights up and remains alight when the match is extinguished; but a wave of the hand between the cell and lamp and cell immediately puts the lamp out of action. A duplicate of this apparatus was used by Professor A. M. Tyndall in one of his Christmas lectures delivered at the Royal Institution on January 6th. A novel arrangement, illustrating the reactions between two high-frequency tuned circuits was also shown, the swinging of a suspended coil being continuously maintained by the electro-magnetic force between it and a fixed coil carrying a current generated by a valve, whilst the sudden phase changes characteristic of such a circuit was made audible by clicks in a loud speaker. Another B.T.H. exhibit was a newly-developed rectifier for use in garages, &c., and giving an output of 3 kW at 250 volts. The rectifier utilises two half-wave hot cathode mercury vapour bulbs, and extends the voltage range of the well-known Tungar rectifier. Finally, there was a loud speaker of the "R K" type, but having a cone composed of thin metal instead of paper. Comparative characteristic curves shown indicated a response up to 10,000 cycles per second, and it is claimed that the cone is a better reproducer of "transients" and very high-pitched sounds, than a cone made of paper.

The exhibits of the Igranic Electric Company consisted of electric control apparatus, including a push-button starter for squirrel-cage motors, fitted with a new type of three-phase time lag magnetic overload relay. The capacity of the contactor, which connects the motor directly across the line, is considerably increased by a heavy facing of coin silver on the double break contacts that close and open the motor circuit. There was also a novel type of magnetically-operated contactor designed for heavy capacity and of small space dimensions. There are four breaks in each line, and arcing is effectively suppressed when the contactor opens under heavy load. A new and compact automatic pressure-operated "across-the-line" starting switch was shown in operation in conjunction with a small motor-driven air compressor and receiver. Other exhibits consisted of a contactor-operated magnetic brake for A.C. circuits and a phase failure and reversal relay for the protection of polyphase motors. The latter is designed to give absolute phase protection to a running motor, and will open the control circuits upon the reversal of phase rotation. It operates on the principle of an induction disc wattmeter movement, and utilises a mercury switch to break the control circuit of the motor. When the coils of the relay are energised with proper voltage and phase rotation, the mercury switch is held in the running position by the torque induced in a copper disc. Phase reversal reverses the torque, whilst phase failure reduces it and allows the switch to open.

Among the exhibits of Negretti and Zambra was an experimental hygrometer for cold storage where the air is withdrawn from the refrigerated chamber by means of a hand-operated suction fan and delivered into a sampling chamber. A chromium plated disc mounted in the latter is cooled by means of a CO_2 until dew deposits and the dew-point temperature is observed with a glass thermometer.

An experimental 5in. diameter compensated aneroid barometer exhibited has a range of 28in. to 32in., with its scale divided to 0·010in., permitting estimation to 0·002in. The movement consists of two sets of hardened and tempered steel diaphragms, the free ends of which are connected to opposite ends of a duralumin balancing lever, which is mounted on a tempered steel spring fulcrum to avoid backlash or friction. Movement of the balancing lever is transmitted through a magnifying lever mechanism to a chain and arbor on the pointer spindle. Features of the instrument are the balancing of the movement, ample pointer control, and small hysteresis error.

A flow controller which was on view is designed to operate in conjunction with an orifice plate installed in a water pipe line. The two pipe lines from the connections on either side of the orifice are led to the top and bottom of a vertical brass cylinder, in which there is a "float" or "piston" having a piece of soft iron in the lower end. The clearance between the float and the cylinder is such that a small upward flow past the float, due to the differential pressure at normal flow through the main orifice, is sufficient to carry the float to the top of the cylinder. A pivoted horse-shoe magnet carrying a mercury tube switch is operated magnetically by the soft iron in the "float," and contact is made or broken when the flow drops to a predetermined minimum.

George Kent, Ltd., were exhibiting a temperature controller which enables the temperature of a fluid to be controlled within extremely fine limits by regulating the heat supply to the fluid. The apparatus is designed for the particular case of controlling the temperature of oil by regulating the supply of fuel to the burners, and is so sensitive and quick in operation that it enables constant temperature to 1 deg. Fah. to be maintained. The apparatus is entirely automatic, but push-button control is also provided, should the automatic gear fail. Another exhibit was a portable air flow indicator, which provides an inexpensive means of obtaining the rate of flow of compressed air.

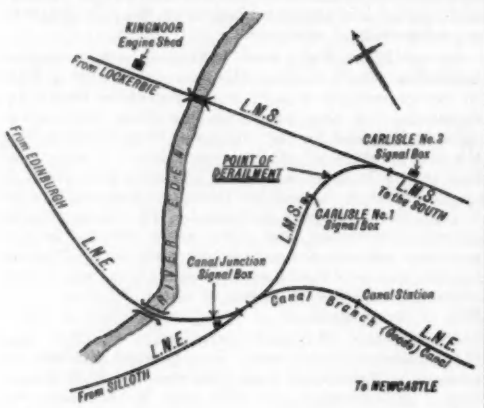
Moving iron Mumetal instruments for A.C. and D.C. measurements were among the exhibits of Crompton Parkinson, Ltd. By the use of Mumetal irons, sub-standard accuracy can be obtained on milliammeters or low-range ammeters on either D.C. or A.C., and at any frequency from 25 to 500 periods with one calibration on a single scale. The moving parts are very light, the torque-weight ratio is high and the damping period is exceptionally good. The company's moving coil D.C. universal indicators, which were also exhibited, are designed to give full-scale deflection at 75 m/v. and 75 m/a., and by means of external shunts and resistances readings of any current and potential may be obtained. The company's "Alltest" D.C. portable multi-range testing set, also shown on the stand, has the same self-contained ranges as the firm's "universal" indicator, and is suitable for taking current and potential measurements when used with external multipliers. Its range is almost unlimited, as it is suitable for measuring currents from milli-ampères upwards and voltages from 600 down to milli-volts. Two patterns of the firm's 3in. dial moving coil calibrated pointer galvanometer were shown. These galvanometers are of the central zero type, with self-contained ranges of 2 m/a. and 80 m/v. One of the instruments that was shown has even scale divisions and the other an uneven scale with wider divisions at zero, giving double the sensitivity of the evenly scaled galvanometer. The instruments are very robust and may be subjected to a temporary overload of thirty-five times their full-scale current. Other exhibits consisted of the firm's "A.C. test" portable A.C. multi-range ammeter and multi-range voltmeter with a single movement, a potential indicator and the well-known Crompton-Robertson bridge potentiometer.

Nalder Bros. and Thompson, Ltd., were showing several new instruments, including a deflectional type frequency meter of novel construction and fitted

with a "no-volt" device, which returns the pointer to the "off" scale position when the supply to the instrument is cut off. The new frequency meter works on the induction principle, and its outstanding features are (1) that the two opposing torques have a common component rendering the instrument readings independent of temperature and voltage variations, and (2) no condensers are employed. The instrument can be arranged to give a frequency scale of 40–60 or 45–55, or 20–80 cycles per second at any desired voltage. Other instruments shown were the Nalder-Lipman type induction wattmeters and ammeters and voltmeters, all parts of which were exposed for inspection. The firm's precision dynamometer type instruments have recently been completely redesigned, and many important improvements have been introduced. The moving system is extremely light and the instrument is dead beat. The damping device consists of two very light symmetrically-disposed vanes, which are enclosed in chambers made as nearly airtight as possible. The frame supporting the field coils is made of a special high-resistance material and is so shaped that eddy currents are reduced to a negligible quantity. The substandard instruments are fitted with knife-edge pointers and mirror scales, and the readings can be taken with great precision. A small portable phase sequence indicator exhibited shows at a glance the sequence in which the E.M.F.'s reach their maximum values, the windings being suitable for pressures ranging from 50 to 500 volts at any commercial frequency.

The Carlisle Fatal Railway Accident.

THE accompanying map shows the lines concerned in the derailment of the 12 noon London and North-Eastern express from Edinburgh (Waverley) to Carlisle on January 3rd. The line on the left is the original North-Eastern Railway from the Newcastle and Carlisle line to Canal Station, which was extended to Port Carlisle on the river Solway when the Carlisle Canal was converted into a railway. Of this particular branch, the Silloth line was subsequently built. The North British Waverley route from Edinburgh joined the Port Carlisle branch at Canal Junction, and from the same point the Caledonian Railway put in the connection shown up to Carlisle No. 3 signal-box, which gave the North British access to Carlisle Citadel Station. It was on the last-named connection that the derailment occurred. The North-Eastern and North



"THE ENGINEER"

SKETCH PLAN OF LINES NEAR CARLISLE

British are now part of the London and North-Eastern system, and the Caledonian is absorbed in the London, Midland and Scottish.

The circumstances that led up to the accident were inquired into, on behalf of the Ministry of Transport, by Lieut.-Colonel Mount, the Chief Inspecting Officer of Railways, who sat all day on Tuesday, the 13th, and until late the following day. From the evidence given, it appears that the train consisted of seven bogie coaches, of which the third from the front was a restaurant car. It was drawn by engine "No. 2758," "Northumberland," a 4–4–0, with six-wheeled tender, of the "Shire" class. A view of one of this class of engine was given in a Supplement to THE ENGINEER of January 6th, 1928, and a weight diagram is to be found on page 20 of that issue. The weight of the engine in working order was 65 tons 11 cwt., and of the tender 52 tons 13 cwt., a total of 118 tons 4 cwt. It was put into service, new, in the Scottish area on April 4th, 1930, and at the time of the accident it had run 81,777 miles. As the mileage for shopping this class is 80,000 miles, it was advised to be sent to the shops on December 4th. The driver, John Eskdale, was spoken of by his running shed foreman as a very reliable man, and, he believed, a total abstainer. A good report was also given of his fireman.

Evidence was given that the train was in good order when it left Edinburgh, and the driver said he had a "perfect" brake throughout the journey. He lost 5 min. in running when ascending Fallowhill bank—9 miles of 1 in 70—owing to bad coal—an excuse that was accepted by the running department—and three more minutes, owing to the engine being in an awkward position to take water from the column at Galashiels. There are several speed restrictions between Edinburgh and Canal Junction, Carlisle, all of which Eskdale apparently obeyed. Approaching the last-named point, where there is a speed restriction of 10 m.p.h., he said he shut off steam when 1200 yards from Canal Junction, passed through the junction at 10 m.p.h., and had entered upon the curve towards No. 3 box where there is a speed restriction of 15 m.p.h., when the engine "fell over under him." Three passengers were killed and twenty-four passengers and six servants injured.

After the accident, which occurred at 2.35½, the first coach was found near the engine, the second had broken away and was across the main line, the third had overrun the tender, which had fallen on its side on the top of the third carriage, and the fourth mounted the *débris* of the first and third. The engine dug a trench in the ashes by the side of the line and made a cone 15ft. deep, in which it so completely buried itself that only the ring of the funnel was visible. When the ashes had been cleared away the regulator was found closed, the reversing gear in full forward position, and the brake valve in the running position. At 4.30 p.m. the engine had only 40 lb. of steam. This particular subject may be disposed of by saying that, when lifted, it was found that the left-hand wheel guard was broken off. This, by a strange coincidence, was found on the morning of the second day of the inquiry, but in advance of the assumed point of derailment. The left-hand leading bogie wheel was worn a full ¼in., but whilst nearing the time for re-turning, it was not sharp.

The road between Nos. 1 and 3 signal-boxes at Carlisle was relaid with Caledonian standard 95 lb. rail in 1915, and it was re-sleepered and re-chaired in 1928. From the boundary with the L. and N.E. at Canal Junction to No. 1 box it was ballasted with stone; from No. 1 to No. 3 with ashes. The latter was quite a good road and there had been no trouble with the drainage. The first 15 chains from the boundary were on a left-handed curve of 20 chains radius; then followed 200 yards of straight and the remaining 18 chains to No. 3 box were on a right-hand curve of 10 chains. The last-named length had a check rail and a superelevation of from 3¾in. to 4in., with a gauge of ¼in. wide and suitable for a speed of 15 m.p.h., which was the limit laid down. After the accident the line was found to be distorted and the chairs broken for 20 yards in the rear of the assumed point of derailment. For 46ft. the outer jaws of the chairs of the outer rail were broken off and for 68ft. the inner screws of the check chairs were bent and the inner jaws broken.

Whilst it may seem obvious that the derailment was caused by excessive speed and there was evidence in support of such a conclusion, there was also equally strong testimony to the effect that the speed was not higher than what is usually maintained over this section of line; that speed, however, has been considerably above the limit laid down.

The coroner's inquest has still to be completed; it stands adjourned until February 17th.

South African Engineering Notes.

The Fuel Research Board.

PRELIMINARY work in connection with the Fuel Research Institute is proceeding steadily, but there is little possibility of any important work necessitating expenditure being undertaken until the return from Europe of Mr. A. P. J. Fourie, the Minister of Mines and Industries. The Institute, of course, has some very important functions, including coal grading, which it inherited from the now defunct Coal Grading Commission. As is the case with so many of the Boards appointed by the present Government, a point is being made of secrecy, and the Chairman of the Institute, Dr. J. S. van Lingen, has issued strict instructions to his colleagues not to divulge any information to the Press. It is expected that when all preliminary details are settled, a statement may be issued, when, of course, the question of whether the headquarters of the Institute will be in Johannesburg or Pretoria will have been definitely decided.

Loading Manganese Ore.

The ore-loading plant which has been laid down next the entrance to the Congella graving dock, Durban, by the Manganese Corporation (1929), Ltd., was recently completed, and a number of cargoes of manganese ore have already been dispatched overseas, some as far as Japan. Storage accommodation has been provided for 50,000 tons of ore, so that irregular truck supplies or traffic congestion should not affect the ships when shipment is in full swing and a reserve has been accumulated. The loading of the ore, whether from the storage pile or direct from trucks, will be accomplished at the rate of 500 tons an hour, and the work will be done automatically, all the gear being electrically driven. Trucks on arrival are spotted on a lifting tippler and their contents discharged into a hopper. The empty truck then runs down an incline over a set of spring-controlled points, and up a further incline, when it will reverse by gravity and on return will take the points and run out into the "empty" sidings. From the hopper the ore will be carried by a rising conveyor belt on to a long raised conveyor belt at right angles, running the full length of the quay and storage pits. Running on the structure carrying this belt is a traveller having two conveyor belts at right angles to the long main belt. One of these plumbs the holds of the ore ship and the other the storage bin. The main conveyor belt runs over a special ramp, which is coupled to the main traveller and moves with it. This raises the ore so that it may be discharged on to either belt on the traveller, thus reaching the hold of the ship, or the storage pile, according to the belt in use at the time. Below the storage pile is a reclamation tunnel, 480ft. long, with doors through which the ore can be fed on to a return conveyor belt. This latter belt brings the ore back to the first-mentioned rising belt, which despatches it once more towards the main traveller for discharge into ship's hold. The complete plant has cost approximately £40,000, and it was designed and erected for the Corporation by Wellman, Smith, Owen, of South Africa (Pty.), Ltd.

German Expert for New Steel Works.

Herr Ernst Kerl, a German steel expert, has been appointed to the most important technical post in the South African Steel Works, to be erected at Pretoria. Dr. H. J. van der Byl, Chairman of the Board of the South Africa Iron and Steel Industrial Corporation, in an interview on December 1st, said that Mr. Kerl had been appointed to assist in the building of the works at Pretoria and then to take charge of the smelting and rolling mill departments. Dr. van der Byl hopes that Herr Kerl will eventually qualify to become general works manager, as he holds the world's record for steel smelting in the works he designed in Germany. Mr. A. K. Rees, who was appointed as a consulting engineer some months ago, and who is chairman of the Concern's Committee of Consulting Engineers, is, Dr. van der Byl states, famous as a blast-furnace expert, and with Mr. Rees and Herr Kerl co-operating, Dr. van der Byl considers the Board has an excellent combination for establishing the work of putting the industry into full running order.

Doubling Natal Main Line.

The Railway Board inspected, in December, a section of the Natal main line—known as the tunnel section—for the purpose of estimating the cost of doubling it. The tunnel section is that between the stations Dassenhoek and Cliffdale, and it winds almost continuously through tunnels. It will entail very heavy expenditure at a time when economy is a primary consideration, but, in view of the importance of the line, the doubling cannot be indefinitely postponed. It is further stated that if the line is doubled provision will at the same time be made in the tunnels for the future extension of the electrification system to Durban. This development has been repeatedly urged by the Chairman of the Electricity Supply Commission, who has pointed out that it is only by linking the super-power stations at Durban and Colenso that the Administration can secure economical working by electric traction. The electrification of the Durban city line, it is stated, can be carried out at small cost compared with the heavy original outlay on the section between Maritzburg and Glencoe Junction. Meanwhile, it is understood that the Administration is anxious to extend the electrification from Masons Hill down the main line as far as Thornville or Umlaas-road, and this extension may be undertaken next year. The Railway Administration has been busy doubling the new main line for several years. From the city end the line has been doubled as far as Cliffdale. During the present year the Administration has been pushing on with the doubling of the line from the Durban side under capital and betterment votes already sanctioned, but unless substantial capital expenditure is voted for the tunnel section the work must come to a full-stop at Dassenhoek.

LAUNCHES AND TRIAL TRIPS.

WILLIAM STRACHAN, motor vessel; built by Workman, Clark (1928), Ltd., to the order of Messrs. Opper and Sorensen's Tankrederi A/S, Oslo; dimensions, 422ft. by 55ft. 3in. by 33ft. 6in.; to carry cargo and oil in bulk. Engines, oil, Workman, Clark-Sulzer type; constructed by the builders; trial trip, December 15th.

APPALACHEE, motor vessel; built by Palmers Shipbuilding and Iron Company, Ltd., to the order of Anglo-American Oil Company, Ltd.; to carry oil in bulk. Engines, oil (Doxford type); constructed by the builders; trial trip, December 16th.

KARANJA, twin-screw steamer; built by Alexander Stephen and Sons, Ltd., to the order of British India Steam Navigation Company, Ltd.; dimensions, 470ft. by 64ft. by 41ft.; to carry passengers and cargo. Engines, steam turbines; constructed by the builders; launch, December 18th.

SOMALI, single-screw vessel; built by Harland and Wolff, Ltd., to the order of P. and O. Steam Navigation Company, Ltd.; dimensions, 458ft. by 60ft. 6in. by 40ft. 9in.; to carry owners' eastern trade. Engines, quadruple-expansion and exhaust turbine, pressure 230 lb. per square inch; constructed by John G. Kincaid and Co., Ltd.; trial trip, December 18th.

ELISE, single-screw oil tank motor ship; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Mr. Carl Bech, of Oslo; dimensions, 460ft. by 59ft. 7in. by 33ft. 7in.; to carry 11,500 tons. Engines, oil; constructed by the builders; launch, December 19th.

TJISADANE, motor ship; built by the Netherland Shipbuilding Company, to the order of the Java-China-Japan Line; dimensions, 458ft. by 62ft. by 38ft. 6in.; to carry passengers and cargo. Engines, oil; constructed by Werkspoor; launch, December 20th.

MACDHUI, single-screw motor ship; built by Barclay, Curle and Co., Ltd., to the order of Burns, Philp and Co., Ltd., of Sydney, N.S.W.; dimensions, 340ft. by 51ft. by 31ft. 6in.; to carry passengers and cargo. Engines, oil, Burmeister and Wain-Harland and Wolff type; constructed by John G. Kincaid and Co., Ltd.; launch, December 23rd.

HISTORY OF SCIENCE AND TECHNOLOGY.—The Second International Congress of the History of Science and Technology will take place in London from Monday, June 29th, to Friday, July 3rd, 1931. The headquarters will be the Science Museum, South Kensington. The Congress originated with the Comité International d'Histoire des Sciences, which was founded at Oslo on August 17th, 1928. This body meets annually in Paris and organises every three years a Congress in which persons interested in the history of science and technology are invited to take part. For the coming Congress the Comité has been fortunate in enlisting the co-operation of its parent body, the Comité International des Sciences Historiques, together with that of two other international societies, the History of Science Society, New York, and the Newcomen Society for the Study of the History of Engineering and Technology, London. The aim of the Congress is to provide opportunity for intercourse and exchange of thought between all those who are interested in the various departments of the history of science and technology. The programme is being arranged to cover the period indicated. Besides scientific communications, there will be social gatherings, visits to institutions and excursions to places of historic interest. The Secretary is Mr. H. W. Dickinson, at the Science Museum, South Kensington, S.W. 7.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trading Conditions.

THE wheels of industry in the Midlands and Staffordshire have gathered but little additional speed during the past week. Rolling programmes at many of the Black Country mills are so uncertain that the resumption of work, delayed in some cases until this week, is hesitating, and production is proceeding at no more than half capacity. Demand alike for iron and steel is low in all departments, and works managers are waiting week by week for orders to keep the plant going. In many cases they are disappointed, and by the middle of the week the works are temporarily closed down. Orders are very scarce, and no large amount of business appears to have been provided, either at last week's quarterly meeting or since. Business is done cautiously, and on the basis of providing only for current consumption. There is a decided tendency against forward contracting, users being of opinion that values have not yet reached bottom. The fact that present production is probably in excess of consumptive requirements, and that there are considerable stocks in many branches ensures that what material is required from week to week can be secured. It looks very much as if users are determined to throw on to the shoulders of producers the burden of carrying stocks and bearing the possible consequences of depreciation of values. The future is full of uncertainties.

A Depressing Record.

The Board of Trade returns of overseas business in December are indeed disquieting, and they complete the melancholy record of the year 1930. British, and particularly Midland, trade has been more or less depressed for some years now, but I think it would be perfectly safe to say that the year just ended proved the most unsatisfactory and unremunerative of them all for manufacturers in this district. The only bright spot is the electrical industry, for here an increase of about half a million in the value of exports of electrical equipment is shown. How much longer, it is asked here, is the tale of increasing imports and decreasing exports to go on? The outlook is not encouraging. There is little real ground for optimism, but industrialists in this area will continue the fight they have been waging so desperately of late, in the hope that their energies, sacrifices, and perseverance will bring a just reward.

Tube Mill Plant for America.

No news is so welcome in Midland industrial circles just now as that of the receipt of new orders. It is therefore with pleasure that I am able this week to report that a large order, which, it is anticipated, will keep the Darlaston, Staffs., works of the Wellman Smith Owen Engineering Corporation, Ltd., busy for many months, and give employment to hundreds of men, has just been received from the Jones and Laughlin Steel Corporation, of Pittsburg, United States of America. The order is for a complete seamless tube mill, including the supply of auxiliary equipment and other units, all for manufacture at Darlaston, and is reported to be the first result of a consulting arrangement between Wellman Seaver Rolling Mill Company, Ltd., and the Jones and Laughlin Steel Corporation, the former being a subsidiary and sales company for the Wellman Smith Owen Engineering Corporation, Ltd. This Midland firm, despite the general trade depression, is well employed, and at the present moment a large seamless tube mill for Canada is nearing completion at the works.

Orders for Midland Firms.

Amongst the fortunate firms which share in the substantial contracts recently given out by the Great Western Railway Company are a number in the Midlands. Steel girders and other steel and ironwork required for the reconstruction and widening of the public road overbridge near Rogerstone Station is to be supplied by the Patent Shaft and Axletree Company, Wednesbury. J. Hill and Sons, of Stourbridge, are to supply and erect a 6-ton Goliath crane at the new erecting shop, Wolverhampton, while Evans Lifts, Ltd., of Leicester, are to supply and erect an electric 3-ton lift for the goods shed, Paignton. Fletcher and Co. (Contractors), Ltd., of Mansfield, have been entrusted with earthwork, drainage and roads construction in connection with additional goods accommodation near Soho and Winson Green Station, Birmingham.

Steel Values.

Interest this week centred chiefly round finished steel and the possibility of a change in selling prices. For some time past there has been an insistent demand for lower prices, and speculation was rife as to the attitude which the associated steelmasters would adopt at their meeting this week. During the past year the Association has maintained its price level, despite the changes in other branches of trade, and it was considered quite an open question whether it would now see fit to announce a reduction. The solidity of steelmasters in face of the very difficult conditions which have ruled, including a marked contraction of demand, has proved something of a surprise to many merchants and manufacturers. Steelmasters may hold that there is little prospect at date of any reinvigoration of demand as a result of price concessions, and that present output does not justify lower selling rates. In some buying circles it is held that there is a potential demand for finished steel, and that it depends upon the action of steelmasters whether it develops or not. Steelmasters hereabouts doubt the authenticity of this statement, however. They fail to see any evidences of an early expansion of demand. At date most branches of engineering are poorly engaged. On the constructional side, the position is said to be slightly better, but this applies to big concerns which have some large overseas contracts on hand. Other steel users, with the exception of automobile engineering firms, report declining activity, and the steel supply is in excess of the demand. Midland mills which roll joists and plates are in a better position than those concerned with sections. The explanation given is that the smaller constructional jobs in which section steel is principally used are not being put in hand, owing to financial stringency. There is not a steady output of joists and plates; nevertheless, operations are less cramped than in the other department. Up to the time of writing, the steelmasters' decision as to selling prices had not been announced, and it is impossible to anticipate the probable result of their deliberations. In the uncontrolled steel department the disparity between native and foreign prices constitutes a serious hindrance to business. Staffordshire steelmasters have reduced their prices time and time again in an endeavour to secure a greater proportion of the available orders, but their sacrifices have met with but little reward. Business at date is very sluggish and importing merchants complain equally with native producers about the volume of orders received. Small rolled bars are quoted at last week's levels of £7 7s. 6d. upwards and billets at £5 12s. 6d. upwards.

Raw Iron.

There is no change on the week in the trade position in the Midland pig iron industry. Selling prices are fixed until the end of the month and as almost every user is buying only for immediate use, little interest is displayed in this side of the market. Blast-furnacemen, however, are anxiously watching for signs of an expansion of demand, for they have stocks which they are anxious to liquidate. This applies particularly to Northamptonshire furnacemen. In Derbyshire furnacemen have an opening for their output because of the sustained activity at the pipe foundries, and therefore have not such an accumulation of material. Diligent inquiries amongst foundrymen in this area fail to reveal immediate prospect of a revival in trade, and buying is likely to remain below the level of pig iron production. The situation is no better, indeed it is worse, in the forge branch. Here business is decidedly bad. With demand low and stocks large, foundrymen and forgemen consider the time suitable to reiterate their demand for cheaper iron. Between now and the end of the month they are bound to let producers know their views on the subject, and in some quarters it is said business is being withheld in order to strengthen the hands of consumers. Previous recent reductions in raw iron prices have failed to stimulate buying, however, and this fact is bound to weigh heavily with the smelters when they consider the question. The reduction of 5s. per ton in Cleveland pig has further strengthened the case for cheaper pig iron in this district. Moreover, unless the Central Pig Iron Producers' Association makes some counteracting move, there is likely to be some displacement of trade in South Yorkshire, Lancashire and other markets, where Derbyshire blast-furnacemen have been selling successfully. Any material change in the distribution of business is likely to be of considerable moment to Derbyshire smelters and might easily mean a further curtailment of output. It is possible, therefore, that in so far as the Northern markets are concerned, at any rate, prices of Midland iron will be reduced in the near future. It is doubtful, however, whether the same will apply to selling rates in this area. For the present, values remain unchanged, Derbyshire No. 3 foundry being at £3 11s., forge £3 6s., Northamptonshire foundry £3 7s. 6d., and forge £3 2s. 6d., delivered Black Country stations and subject in some cases to rebate.

Finished Iron.

The conditions in South Staffordshire continue unsatisfactory. Short-time is being worked at the finished iron rolling mills. Some fortunate firms were open last week, but a few have not yet been able to make a restart. In a great many cases it is necessary to curtail activity to about three days a week. Prices have not altered in any of the different brands of finished iron. Marked bars stand at £12 10s. Crown bars at £10 to £10 7s. 6d., nut and bolt and fencing bars at £9, and iron tube strip at £10 17s. 6d.

Galvanised Sheets.

The galvanised sheet trade is still very quiet, the price standing at £11 5s. per ton for 24 gauge f.o.b. The reduced exports to India made a big difference to the galvanised sheet industry last year, and another blow at this trade has been struck by the increase of duty on English sheets from 30 to 67 rupees per ton. The position is the more disconcerting as the increase is to apply for the ensuing three years.

Coal Settlement in Warwickshire.

The dispute in the Warwickshire coalfield has been settled, the owners and miners having come to terms which will ensure at least a continuance of work until the end of March. The agreement was brought about by the acceptance by both parties of the formula drawn up at a joint meeting in Birmingham last Thursday for a temporary agreement to regulate hours and wages. The terms of the adjustment are (1) to put into operation at next make-up day the 7½-hour day and Saturday 5½ hours for a three-quarter shift; (2) to pay the basis rates, plus 47 per cent. for the month of January, 43 per cent. for the month of February, 40 per cent. for the month of March, plus 6 per cent. on basis rates for pieceworkers underground. Arrangements as to subsistence wages are to remain as at present. It was agreed that a sub-committee should meet to settle the details and to consider future wages arrangements after March 31st.

Discontent in South Derbyshire Coalfield.

In the South Derbyshire coalfield, dissatisfaction is expressed at the manner in which the coalowners have up to now operated the spread-over principle, and at a recent meeting of the District Miners' Association the miners' agent was instructed to prepare a questionnaire in order to obtain definite information from the various branches, preparatory to taking action in the matter. It was reported that systematic overtime was being worked by several collieries in contravention of the Coal Mines Act, and the agent was instructed to deal with the matter immediately.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Year's Trade in Textile Machinery.

UNSATISFACTORY as was the whole of the past year in respect of export business in textile machinery, the month of December was by far the worst of the twelve, even after making adequate allowance for seasonal influences. The value of shipments during that month was little more than half the value in the corresponding period of the two previous years, the total at £484,777 comparing with £848,967 and £876,667 in 1929 and 1928, respectively, and with a monthly average of nearly £1,000,000 in each of those two years. Taking the past year as a whole, exports were valued at only £8,628,302, or almost exactly £3,000,000 below either the 1929 or 1928 figures. Of the shipments during the twelve months under review, 72,546 tons, valued at £6,626,500, represented spinning and twisting machinery, and 14,462 tons and £1,297,393 weaving machinery. Curiously enough, having regard to the difficulties of trading with that country, Russia was the only market to register an increase compared with the preceding year. France and China were still relatively good customers for British plant of this kind, but exports to all other markets, and particularly to British India, Japan, Germany, the Netherlands, the United States, and South America, were appreciably smaller than in recent years. British India, however, was still the leading market, with takings valued at £2,513,439, followed by France with £774,592, Russia £760,509, China £706,562, Japan £434,609, the Netherlands £386,367, Germany £382,455, the United States £305,564, South America £242,281, and Australia £192,988, shipments to "other European countries" during the past year reaching an aggregate value of £1,451,021.

Bid for New Industries.

Dictated by the continued acute depression in the cotton industry of the county, and following the lead already given by individual towns, a concerted effort is to be made to attract new industries to Lancashire. The initial step was taken on Monday of this week by the Manchester Chamber of Commerce, when the directors decided to send invitations to the Chambers of Commerce of Liverpool, Warrington, Blackburn, Oldham, Bolton, Bury, Preston, Stockport, Burnley, Widnes and Runcorn to send representatives to a private conference to be held next Tuesday. Preliminary discussion will necessarily be mainly of an informal character, but the practical result will probably be of direct interest to the engineering and allied industries, which already occupy an important position in Lancashire economics.

Another Bridge for the Mersey?

Plans have been prepared for a two-span, reinforced concrete bridge, 60ft. wide, to cross the river Mersey at Manor Locks, Warrington, and they will, it is expected, shortly be submitted for approval to the authorities. The traffic congestion problem is particularly acute at Warrington, as at present the centre of the town has to carry the voluminous Manchester-Liverpool traffic, which crosses the river at Bridge Foot. The new scheme would also effect a diversion of traffic to Chester and towns on the North Wales coast.

Non-ferrous Metals.

Loss of ground has been general in all sections of the non-ferrous metals market during the past week, with fluctuations in respect both of demand and prices experienced in most cases, and more especially in tin and copper. A certain amount of reaction in the tin market was, perhaps, only to be expected, and on that account alone the net loss on balance for the week of about £5 a ton need not necessarily be disquieting. The downward movement developed largely in the early days of the present week, following upon a period of fair buying, both for trade and speculative purposes. Nothing further has occurred yet in connection with the latest scheme of output control, and the future of the market is still, therefore, of an uncertain nature. Copper has failed to maintain the highest point touched during the week, and a relatively poor demand for the metal from consuming interests, coupled with poor prospects of early improvement, served to depress prices of standard brands compared with a week ago to the extent of between 17s. 6d. and 20s. a ton, according to position, refined descriptions also tending easier. The position of spelter is particularly depressing, prices during the past week having reached a new "low," with the tone of the market at the time of writing the reverse of steady. The old trouble of excessive stocks of this metal persists. Following upon last week's loss of about 10s. a ton, English lead is 5s. easier, with the decline in foreign metal rather less pronounced.

Iron and Steel.

Trade in iron and steel products on this market since last report has been on quiet lines, with users in most instances, more especially in respect of steel, prepared to await price developments. Buying of foundry iron has been on a hand-to-mouth scale, with not a great deal being done in the aggregate, for the majority of Lancashire foundries have already commitments which will carry them over this month. A satisfactory feature of the position in this section is that deliveries into consumption since the beginning of this year, allowing for the first week's inactivity, are little if anything below the pre-Christmas level. Midland brands of pig iron range from 68s. to 69s. 6d. per ton, according to make, with forge quality at 64s. 6d., North-East Coast foundry at about 71s.,

Scotch makes at 90s. to 91s., and West Coast hematite at 84s. 6d. per ton, all for delivery Manchester or equal distance. Bar iron is still a disappointingly slow market, although quotations remain at £10 5s. per ton for Lancashire Crown quality bars, and £8 15s. for No. 2 material. The movements of heavy steel have been slacker than ever, users being strongly hopeful of this week's Association meeting resulting in concessions of some kind. In the meantime, there has been no sign of general improvement in the position of the Lancashire steel-consuming industries, and at the moment sellers are not inclined to take even a moderately hopeful view of the outlook.

BARROW-IN-FURNESS.

Hematite.

The most important item of news this week is the announcement that the rail mills and ironworks at Barrow are to re-start next week. This is good news, indeed, for it not only means the absorption of over a thousand idle hands, but it suggests that at last there is a turn in the lane. What the future holds, in so far as bulk of contracts is concerned, cannot be stated at present, but it can certainly be said that, generally, the signs are better. Stocks still exist in considerable tonnage, and it will be some time before they cease to cause anxiety. On the other hand, if the demand for iron increases to such an extent as to cause a rise in the price, then iron stocks will appreciate in value and prove a satisfactory investment. The re-starting of the Barrow furnaces, naturally, means an increase in the demand for pig iron and fuel, apart from causing greater activity on the local railways. Generally speaking, there is not much life in the steel trade, but the outlook is not so bad as it was. Shipments last week were very quiet.

SHEFFIELD.

(From our own Correspondent.)

Idle Steel Furnaces.

TRADE in open-hearth steel, alike as regards basic and acid qualities, continues on a very unsatisfactory scale. The number of furnaces in commission is about the same as before the holidays, but bulk business is so scarce, and inquiries so unpromising, that there is a danger of further curtailment of production unless something occurs shortly to stimulate buying. How bad the position is on this side of local industry was forcibly brought out last week by Mr. Walter Dodgson, J.P., the divisional secretary of the Iron and Steel Trades Confederation, who also suggested a drastic remedy. Mr. Dodgson, who was addressing the members of the weekly luncheon club of the Sheffield Trades and Labour Council, said that it was questionable whether as much steel was being produced in Sheffield now as immediately before the war. It was certain that they had not the same number of steel furnaces in commission as they had before the war. In the division for which he was responsible, there were 118 Siemens furnaces, of which only 33 were in operation. He went into details with regard to the two rationalised concerns in the district—the United Steel Companies and the English Steel Corporation—showing that, immediately before the Christmas holidays, the former had 11 furnaces in commission out of a total of 44, and the latter six out of 24, or only 25 per cent. in each case. When it was borne in mind that the capacity of these furnaces was from 40 to 150 tons, the magnitude of the slump in the matter of steel production would be readily realised.

Prohibition of Imports.

Discussing a possible remedy for this state of things, Mr. Dodgson dealt with the fiscal aspect of the question. He was satisfied, he said, that the Free Trade theories of Cobden and Bright no longer harmonised with world-wide industrial and social developments, and, personally, he did not see how any theory of Protection, such as the imposition of a tariff, could be applied successfully. To illustrate his argument, he quoted current prices of steel from Belgium, France and Germany, adding that British prices were approximately 60 per cent. higher. "No tariff," he urged, "no matter how substantial, could prevent importations of this character entering our home markets, and to me it would seem that nothing short of the application of the law of prohibition meets the case." It was also interesting to have Mr. Dodgson's views on the state of the steel plants in the district. He remarked that much had been said about the reorganising of our plants. As to that, he had to point out that they had, in his division, plants which were second to none, and which compared very favourably with the best plants on the Continent with respect to efficiency.

The Manufacturing Side.

The outlook for railway axles, tires and springs continues poor. The shops producing these supplies are only moderately employed, and the economies which the home railway companies are practising do not promise any improvement. There is a fair amount of activity in drop forgings, and one of the local plants has been modernised and enlarged. The forgings are made for a variety of purposes, the lighter varieties going principally to the motor industry, which is taking fair quantities for use in commercial cars, but less than the average for touring vehicles. Trade in cold-rolled steel and strip is still quiet, but, on the side dealing with stainless and heat-resisting steels, a considerable volume of work is on hand, and it is to be expected that this department will continue to progress.

Tool Steel and Tools.

One of the most satisfactory branches of trade is that of high-class tool and alloy steels, which is reported to have started the year with increased orders and inquiries. The motor and general engineers of this country use large quantities of tool steel, and the principal makers are viewing the future with optimism. Exports are restricted by conditions abroad, but still there are engineers in Belgium, France, Germany and elsewhere who specify Sheffield high-speed steel in spite of tariffs and the cheaper price of home-produced material, thus paying a high tribute to Sheffield's quality and reputation. In farm and garden tools, the season is opening slowly, and the volume of work on hand compares unfavourably with what is usual at this time of year. Agriculturists had a bad season last year, and are, therefore, not likely to be large buyers. Exports in this department, in common with other branches of local trade, have been on the down grade for months past. In some localities, dealers have considerable unsold stocks of last year's tools on hand. It is hoped, however, that trade will be stimulated by the fact that prices of many kinds of garden tools have been reduced this year. In other classes of hand and engineers' small tools, buying is restricted, but this condition is not viewed with any alarm, as it is customary in January. The outlook for the home trade is regarded as normal, but only a moderate amount of work for export is expected.

Sheffield and the United States.

There was a serious fall last year in the exports of steel from Sheffield to the United States. The total was 460,129 dollars, as compared with 1,050,500 dollars in 1929. Exports of cutlery, valued at 285,367 dollars, showed a fall of 59,000 dollars. Of the cutlery total, 114,634 dollars was represented by safety razor blades, and 99,787 dollars by blanks of blades, and it was chiefly under the latter heading that the decline took place.

Prince and Trade Mission.

A great compliment was paid to the Sheffield Trade Mission to South America this week, when Mr. A. K. Wilson and Mr. C. R. Hodgson, the leaders, were invited to meet the Prince of Wales in London. His Royal Highness, who is shortly leaving for an extensive tour of South America in connection with the British Empire Exhibition in Buenos Aires, desired to consult Mr. Wilson and Mr. Hodgson regarding trade possibilities.

Cutlery and Plate.

The latest instance of rationalisation in Sheffield is furnished by the arrangements which have just been made for the fusion of two of the oldest firms in the silver, electroplate and cutlery manufacturing businesses—those of James Dixon and Sons, Cornish-place, and William Hutton and Sons, West-street. Both concerns are of world-wide reputation. As a result of the fusion, the works of Hutton's in West-street are to be closed, but their showrooms in London and Birmingham will be retained. Trade in these branches has not yet been fully re-started after the Christmas break. As regards general business, the outlook is poor, in both home and overseas markets. There is no likelihood of any considerable orders from the shopkeepers for some time. A large volume of work is on hand, however, for the equipment of hotels and restaurants, and also for goods to be distributed in return for coupons. The latter form of trading is meeting with increasing opposition on the part of retailers. The secretary of the Ironmongers' Federated Association has compiled a list of 250 articles, stocked by ironmongers, which are given away, and he suggests to members of the trade that, before placing orders with travellers, they shall inquire what attitude their principals adopt towards gift schemes. I learn that none of the Sheffield silversmiths who trade through retailers are supplying goods to the coupon firms. There are, however, many manufacturers who are independent of the retailers, and they are doing a large coupon business, in goods of fairly good quality.

Canal Improvements.

The Sheffield and South Yorkshire Navigation Company's canal, which carries great quantities of coal from the South Yorkshire collieries to Goole and the Humber ports, is to be improved with a view to providing increased facilities for this trade. A sum of £20,000 is to be spent this year, chiefly in the lengthening of the locks. With the modern system of transporting coal in "compartment trains" along the canals, small locks are uneconomical, and even with extended locks it is necessary to divide the loads into two for convenience in passage. But coal loaded at the colliery one day will be ready for shipment at Goole the next day, the transport being made during the night.

Bridge Work.

It is likely that the building of the new bridge over the Calder at Wakefield will be started in a few weeks, as Wakefield City Council has now decided to apply to the Ministry of Health for sanction to borrow £78,000 for the purpose. The bridge has been designed by Sir E. Owen Williams, of London. The old Chantry Bridge, which is about 600 years old, will remain, but the road will be straightened from the far side of the river into Kirkgate. At Thornhill Lees, Dewsbury, last week, a concrete bridge erected at a cost of £11,000 over the Calder and Hebble Canal, on the main road from Dewsbury to Barnsley, was formally opened. It is 45ft. wide, with a 30ft. carriageway, and takes the place of a stone bridge which has done duty since 1797, and which, at one point, was no wider than 18ft. 6in.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

MUCH more active market conditions now prevail in the Cleveland pig iron market, and an encouraging view is taken of the outlook. Results have already provided ample justification for the step which the Cleveland ironmasters took in reducing prices. A 3½ per cent. cut in wages may be a small saving to set off against a 5s. cut in prices, but further economies will be possible in the future. At all events, the old level of prices could not be maintained, and the reductions have brought about a welcome acceleration in the flow of orders. Makers have negotiated some useful contracts direct, and merchants have also put through a greater volume of business than for some time past. Export business shows no improvement, but certain firms abroad, which prefer Cleveland products, will soon be negotiating for supplies, if values of foreign pig iron continue to advance. Cleveland pig iron is now cheaper than it has been for seventeen years, and the low level now ruling has checked buying of continental and Midland iron for consumption in this area. Ironmasters are still selling Cleveland iron at specially low prices to consumers in Scotland, where cheap foreign iron continues to arrive. To home users fixed minimum prices stand:—No. 1 foundry, 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

As yet, East Coast hematite pig iron prices have been little affected by the fall in Cleveland iron quotations, though makers and merchants have heavy stocks. The difference in values between the two commodities is greater now than it was in normal pre-war times, when sellers expected to realise, for mixed numbers of hematite, 8s. to 10s. more than they could obtain for No. 3 Cleveland. Terms of sale of hematite vary after individual bargaining, but 70s. is still named for ordinary qualities, and No. 1 quality is at a premium of 6d. per ton. Consumers expect to be able to place orders shortly at 1s. to 1s. 6d. below the figures now asked.

Iron-making Materials.

Foreign ore is still unsaleable, but consumers may soon be able to accept a larger proportion of arrears of delivery against old contracts. The nominal price of best Rubio keeps at 16s. 6d. c.i.f. Tees. Blast-furnace coke is less plentiful than of late, and sellers are inclined to take a rather firmer stand, but ironmasters continue to refuse to pay more than 17s. for good average qualities delivered at the works.

Manufactured Iron and Steel.

Conditions in the manufactured iron and steel industries leave much to be desired. A fair number of constructional steel sales have been made recently, and departments producing bridge-building requisites have now a good deal of work to execute. A few orders for rails are likely to be secured, but specifications for shipbuilding material are not coming forward, and in other branches plant is only moderately employed. When prices are revised, however, business may expand.

The Coal Trade.

Foreign competition, especially Polish, is being severely felt in the Northern coal trade. The East Coast Railways of Sweden have accepted offers from Poland for 15,300 tons of prime steam coal for shipment during May to September. The c.i.f. price is stated to be 16s. per ton, while tenders for the supply of equivalent grades of Durham prime steams were in the neighbourhood of 20s. per ton. The failure of the negotiations to bring about an immediate settlement of the South Wales coal strike has not had much effect on the Northern market, and prospects for the next week or two appear unchanged. Prices show no fluctuations, and remain just nominally steady. The only sign of activity is the demand for best quality bunker coal, for the coaling stations, and also for vessels calling at local ports to replenish supplies, whilst *en voyage* for other destinations. The tone for best-class bunkers, consequently, is very firm. There is little better demand for best Northumberland steam coals, and while surplus stocks for this month's output offer sparingly, there is no pressure from merchants, and values remain quietly firm. Best qualities are on offer at 13s. 9d. to 14s., and seconds at 12s. 6d. to 13s. For small steam coal the demand is extremely slow, and prices are difficult to maintain at higher values than the fixed minimum—best 10s. to 10s. 6d. and ordinaries 9s. 6d. Durham qualities of gas coal are heavily booked up to the end of the month, and merchants continue to inquire freely for further supplies. Prices are quoted firmly at 15s. 6d. to 16s. 6d. Second descriptions are plentiful and in slow demand at 13s. 9d. Durham coking unscreened are in good supply and steady at 13s. 9d. to 14s. There is no real improvement in the demand for blast-furnace coke. On the export side, ordinary foundry coke is dull and values are easy. Gas coke is in less demand than it was in December, but supplies are not excessive. Producers are able to command a steady 21s. 6d. Beehive coke is in limited output, and commands the steady figures of from 24s. to 26s. per ton, according to class.

Colliery May Reopen.

The reopening of Seaham Colliery, which has been closed for three months, is being discussed between the owners and the men, and it is possible that the pit may resume work in a few weeks' time. The colliery is the property of Lord Londonderry, and when working employs 2500 hands.

Coal Quota Raised.

The Northumberland coal trade quota has been raised by 11 per cent. by the Executive Board under the Coal Mines Act. This, it is stated, is in some part due to the fact that if it had not been raised, the collieries would, before the end of the quarter, have exhausted their quotas and would have been compelled to lie idle. There is probably at the moment a bigger demand through the stoppage in South Wales, but even apart from this, it is considered that the raising of the quota is a good thing for the trade of Northumberland. There is considerable doubt as to what the actual amount of the quota is, but it is stated that the point it has reached will bring the output out at about 86 per cent. of the 1929 production.

SCOTLAND.

(From our own Correspondent.)

A Quiet Start.

SINCE the beginning of the year market conditions have been quiet and without alteration. During the past week or two there has been a moderate renewal of inquiries from export markets which may possibly develop into a fair amount of business, and there is a more optimistic feeling as regards the power of home consumers to absorb larger quantities of steel and iron products.

Steel and Iron.

Holidays at the steel and iron works have been of longer duration than usual, and a few days must elapse before outputs assume anything approaching a normal scale. Heavy steel has been under a cloud for some time, but an early improvement is expected. Steel sheets of the heavier type have been short of specifications, and galvanised descriptions have suffered from political action in India, Australia, and South America. At the same time, it is thought that heavy accumulations of stocks abroad also contributed to the lack of business, and as these must now be seriously depleted, fresh business cannot be long delayed, except perhaps in the case of Australia, where new fiscal arrangements are practically prohibitive. Steel tubes also have experienced a very lean period, but here again prospects are a shade brighter, if the latest rumours are substantiated. So far as the iron trade is concerned, there is no evidence of any probable change for the better. Bar iron at current prices is not a profitable proposition in competition with steel, and there appears little chance of easier terms for some time to come. Re-rolled steel bars have suffered a further reduction in price of 5s. per ton, the home price being now £7 and export £6 15s. per ton.

Pig Iron.

There are only five furnaces in blast in Scotland at present. Only one of them is producing hematite, but the output is not easily disposed of, and the price has been reduced 1s. per ton to 75s. home delivery. Foundry iron also is in ample supply, with No. 1 at 79s. and No. 3 76s. 6d. per ton. Shipments of pig iron last week from Glasgow amounted to 623 tons, 97 tons of which went abroad, compared with 1381 tons (560 tons foreign) in the same week last year.

Coal.

The Scottish coal market maintains a firm appearance. Foreign inquiries are still very scarce, but outputs are low and easily disposed of. In any case buyers abroad would not entertain current prices and shippers are not in a position to make concessions over a period under present conditions. Collieries in Lanarkshire and Ayrshire have benefited to some extent from the stoppage in South Wales, especially in respect of single and double nuts, and in all probability orders for round fuels will follow if the stoppage in Wales continues much longer. Home demands have been heavier, owing to colder weather, and local industrial demands have shown a tendency to increase slightly. Aggregate shipments amounted to 163,443 tons, against 156,538 tons in the preceding week, and 212,363 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Situation

AT the time of writing it was pretty well recognised that the prospects of a resumption of work in the South Wales coalfield this week were practically nil, and the feeling was none too optimistic regarding the prospects for Monday next. The fact is that up to now the developments in negotiations have chilled the tendency to be hopeful even, so keen has been the disappointment at the failure of the discussions. Early last week the outlook was regarded as none too hopeful, and then, as the result of the interviews which took place in London between representatives of the owners and the workmen with the President of the Board of Trade and the Minister for Mines, hopes were revived. A formula for further discussions was arrived at, and the representatives of the two sides again met at Cardiff on Friday. During the day rumour chased rumour until the report was circulated that the proceedings between the two parties were merely a formality and that peace was assured. There was, however, to be a rude awakening. Within a couple of hours of the meeting between the two sides taking place it became known that acute differences had cropped up, and eventually it was officially announced that the negotiations had broken down completely on the question of the terms of reference to the independent chairman. In order to arrive at a basis of discussion in London, the owners had given way on one point, that being that work was to be resumed on the basis of six days of 7½ hours, with no reduction of wages, and the men's leaders had made a concession in agreeing that disputes arising on wages should be referred to an independent chairman, whereas, formerly they had insisted on points at issue going to the Industrial Board. Clause 3 of "the basis of discussion" was: "The wage applicable to the new hours to be dealt with at once by the Conciliation Board, and, failing agreement, to be referred to the Independent Chairman, whose decision shall be given not later than January 31st. The date of operation of the wage rate—not later than February 1st—to be decided by the Independent Chairman." The men's interpretation of this was that only the amount of reduction in wages, if any, due to the shortening of the hours from 47 to 45 per week, could be referred to the independent chairman, but this was repudiated by the owners' representatives, who contended that all questions affecting wages, even the minimum and subsistence wage, came within the scope of the reference, as was the case under the old Conciliation Board Agreement. The breach between the parties was definite and, as a consequence, there being no prospect of agreement, the men's leaders cancelled the conference of coalfield delegates called for the following day—Saturday—and there was nothing for it but for the stoppage in the coalfield to continue. Subsequently, arrangements were made for the two sides to go again to London on Tuesday for further interviews with the President of the Board of Trade and the Minister of Mines, and while hopes were held that they would be fruitful of good results, everyone in this district was a bit afraid of being optimistic.

Numbing Influence on Industry.

The continuation of the suspension of work in the coalfield has naturally had a disastrous effect on industry in general in this area. On Monday last, out of 26 dry docks in this district, there were 20 idle, and the work in the repairing yards, generally, has fallen off considerably. So far as coal-loading operations were concerned, only 17 vessels were under the tips, while 71 tips were idle at the various docks in South Wales. The amount of coal standing is negligible, but there are still about 2500 men working at some pits. Shippers are able to get parcels together to make up cargoes, but their number is very small, and all that can be said is that things have not quite come to a standstill. The Great Western Railway Company gave notices to about 1500 of its employees, including tippers, and these notices took effect at the end of last week. A certain number of men were kept on at the various docks, but complaints have been heard that the number has not been sufficient to meet the needs of shippers. The number of men altogether affected on the docks—that is, coal trimmers and others who are unemployed—is estimated at about 3500, while, of course, numerous seamen and dry dock workers are idle. Shipments last week, according to the Great Western Railway Company's returns, only came to 195,600 tons, as against 379,000 tons for the preceding week and compared with 658,422 tons for the corresponding period of last year. New business, so far as the export of coal is concerned, has, of course, come practically to a standstill, though it would not be correct to say that one or two substantial contracts about which so much anxiety has been felt, have yet been lost to this district. The period for which tenders sent in for the Egyptian State Railways' requirements of 155,000 metric tons of locomotive coals were to hold good, expired in the early part of this week, but it is rumoured that negotiations are still proceeding, while, in the case of the Portuguese State Railways' contract, shipments do not begin until February, so that there is time for the coalfield troubles to be settled. The Portuguese State Railways, it now turns out, purchased 200,000 tons of smalls for delivery by the end of June, instead of only 100,000 tons for shipment in a shorter period. Moroccan Railways have also bought about 30,000 tons of coal and patent fuel from this district, but, apart from those orders, nothing of note has been made public in regard to contract operations. Cargoes of coal are coming to South Wales from the North-East Coast, and house coals are also coming from "over the border," but unless there is an early resumption of work at the pits, it is feared that operations at tin-plate and other works in this area will be seriously interfered with, as stocks of coal are very low.

LATER.

The Egyptian State Railways have accepted the tender of Gueret, Llewellyn and Merrett, Ltd., of Cardiff, for the supply of locomotive coals for delivery at Alexandria during March, April, and May at the price of 24s. 8½d. c.i.f. per metric ton. The contract is for a total quantity of 100,000 metric tons, instead of 155,000 metric tons, for which the various firms were originally asked to tender.

Docks' Traffic for 1930.

The Great Western Railway Company has issued its returns of sea-borne traffic at the six ports in this district under its control for 1930. Imports and exports together came to 34,925,479 tons, as against 38,411,909 tons for 1929, a reduction of 3,486,421 tons. Imports alone totalled 4,811,234 tons, as compared with 5,170,866 tons for 1929, while exports amounted to 30,114,245 tons, as against 33,241,043 tons. Coal and coke exports came to 27,386,050 tons last year as compared with 29,802,482 tons for 1929.

North Wales Coalfield Finances.

The independent accountants' report for the North Wales coalfield for the three months ended November last shows a credit balance of £1163, equal to ·33d. per ton on an output of 846,061 tons. The proceeds realised amounted to £545,898, or 12s. 10·85d. per ton, and total costs £544,735, or equal to 12s. 10·52d. per ton. The economic wage certified by the auditors was 2·36 per cent. above the basis rates and the payment of the minimum of 22 per cent. left a deficiency of £72,002, thus increasing the total deficiency carried forward to £3,658,410. The output per man shift worked was 18·38 cwt., and the average wage per man shift 8s. 4·13d.

Current Business.

The coal market has presented an idle appearance throughout the past week. The inquiry has been restricted to small parcels to complete or make up comparatively small cargoes, while, of course, there has been a demand for small lots of coal for bunkers. Prices have varied, the relations of buyers and sellers being, in many cases, a not unimportant factor. Whilst the market as a whole has been nominal, business has been done in large coals at about 25s., through coals at 20s., and smalls at about 1s. or so above the minimum, thus making them about 14s. 6d. Round about 30s. is reported to have been paid for large coals suitable for household use. Patent fuel remains at about 21s. 6d., but pitwood has weakened and is about 22s. 6d. per ton ex-ship.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THOS. VICKERS, Ltd., 14, New-street, Birmingham, has been appointed sole agent in this country for the sale of the well-known "M.O." foundry brand of Swedish charcoal pig iron by Messrs. Gusselhytte Masugn A-B, Gusselby, Sweden.

GEORGE COHEN SONS AND CO., Ltd., of 600, Commercial-road, London, E. 14, ask us to announce that they have purchased the complete plant of several Cornish tin mines for dismantling. The majority of the plant is quite modern, having been installed new during the past three years.

JOHN LYNN AND CO., Ltd., whose head office and works are at Sunderland, ask us to announce that they have transferred their London office from 60, Fenchurch-street, to 23, Leadenhall-street, E.C 3, and that their interests in that area will be under the control of Mr. Alfred Robertson, A.M.I.N.A., M.I.M.E.

ALLOY WELDING PROCESSES, Ltd., and THE PREMIER ELECTRIC WELDING COMPANY, Ltd., ask us to announce that the two companies have been amalgamated and that the new company, which operates as from January 1st, 1931, is known as Murex Welding Processes, Ltd., The address of the offices and works will remain unaltered, namely, Ferry-lane Works, Forest-road, Walthamstow, London, E. 17.

WILD-BARFIELD ELECTRIC FURNACES, Ltd., asks us to announce that it has entered into an arrangement with the Hevi Duty Electric Company, of Milwaukee, whereby all patents granted, pending, and all further improvements and processes will, so far as Europe and British Possessions—exclusive of Canada and Newfoundland—are concerned, be operated and manufactured in England by Gibbons Brothers, Ltd., Dibdale Works, Dudley, and itself at Elecfurn Works, North-road, Holloway, London, N. 7.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., of Rugby, has received an order from the London County Council for two 20,000-kW turbo-alternators, complete with feed pumps, heaters, evaporators and condensing plant. These sets will be installed in the Greenwich power station for supplying power to the L.C.C. tramway system.

WINGROVE AND ROGERS, Ltd., of Arundel Chambers, Strand, London, W.C. 2, have recently received orders for a number of their electric locomotives for use on the Southgate extension of the London Electric Railways and for a Walham Green sewer contract. The same firm has received an order from the Erith Construction Company, Ltd., for two 2-ton elevating platform trucks.

BLACKSTONE AND CO., Ltd., of Stamford, have recently received the following orders:—(*a*) For a 14in. "Unchokeable" pump to raise approximately 300 tons of sand and gravel per hour through 80ft. to 90ft. of sea water; (*b*) for a 4in. portable "Unchokeable" gravel pumping plant with engine, designed especially for use in small pits containing water-logged gravel; (*c*) for two vertical automatically-controlled "Unchokeable" pumps and complete equipment; and (*d*) for four horizontal "Unchokeable" pumps and automatic control gear, specially designed for handling unscreened domestic sewage and hotel kitchen refuse.

THE Great Western Railway announces that the following contracts, to the value of over £56,000, have been entered into:—(*a*) Earthwork, drainage and roadways in connection with additional goods accommodation near Soho and Winson Green Station, Fletcher and Co. (Contractors), Ltd., Mansfield; (*b*) construction of bridges and other works between Cardiff and Ely stations, Ernest C. Jordan and Son, Newport; (*c*) steel girders and other steel works, Horsehay Company, Ltd., Horsehay; (*d*) reinforced concrete work to carry a new coal hoist track at east side of Queen Alexandra Dock, Cardiff, Christiani and Nielsen, London; (*e*) supply of six 50-ton engine hoists at Reading, Laira (Plymouth), Taunton, Weymouth, Landoro (Swansea), and Didcot, Royce Ltd., Manchester; (*f*) work in connection with annual Board of Trade survey for the renewal of the passenger certificate, also general opening up for examination of machinery, &c., of the twin-screw steamer "St. Patrick," Alex. Stephen and Sons, Ltd., Linthouse, Glasgow; (*g*) steel girders and other steel and ironwork for the reconstruction and widening of public road overbridge near Rogerstone Station, Patent Shaft and Axletree Company, Wednesbury; (*h*) supply and erection of one 6-ton Goliath crane for the new erecting shop at Wolverhampton, J. Hill and Sons, Stourbridge; (*i*) supply and erection of an electric 3-ton lift for the goods shed at Paignton, Evans Lifts, Ltd., Leicester; (*j*) repairs to the dredger "Robert Vassal," G. H. Bailey and Co., Ltd., Graham; (*k*) supply and erection of extension to steel-framed corrugated sheet building at Frome Station, Frederick Braby and Co., Ltd., Bristol; (*l*) work in connection with the renewal of the Board of Trade passenger certificate and the load line survey of the steam tender "Sir Francis Drake," Bickle Engineering Company, Ltd., Plymouth; (*m*) supply and erection of a refuse destructor for the concentration yard at Swindon, Meldrum, Ltd., Timperley.

CATALOGUES.

ISENTHAL AND CO., Ltd., Victoria-road, W. 3.—List of mercury switches and relays.

HAMWORTHY ENGINEERING COMPANY, Ltd., Poole, Dorset.—Publication No. 830 of marine oil engines.

MACLAURIN COAL PRODUCTS, Ltd., 150, Hope-street, Glasgow, C. 2.—"The Maclaurin Process of Coal Carbonisation."

WORKINGTON IRON AND STEEL COMPANY, Moss Bay, Workington.—Pamphlet on "A New Iron for Cylinder Castings."

J. POHLIG A.G., Köln-Zollstock, Germany.—Catalogue 1201E, giving particulars of aerial ropeways, hoisting and conveying machinery and constructional steel work.

ZEITSCHRIFT DES VEREINES DEUTSCHER INGENIEURE.—It is with pleasure that we have received and read the January 3rd issue of the *V.D.I. Journal*, which marks the seventy-fifth year of publication of our German contemporary. In a few months the Vereire Deutscher Ingenieure will commemorate the seventy-fifth anniversary of its founding, and the issue of its *Journal*. The *V.D.I. Journal*, under the editorship of Professor Dr.-Ing. Conrad Matchoss, occupies the leading place in German technical journalism, and the issue of January 3rd is appropriately devoted to a review of technical progress made in 1930. In an introductory article Dr.-Ing. W. Hellmich discusses the work of the engineer under the four connected headings of construction, production, management, and organisation. He points out the various ways in which the V.D.I. and its organisation has helped and is helping the work of the engineer, and makes a plea for sound engineering education in the schools, which later will be given breadth by the engineering institutions. A very complete survey of technical progress in 1930, along with some interesting illustrations, is thereafter given. We note that the President of the Verein Deutscher Ingenieure in 1931 is Dr.-Ing. C. Köttgen. We would congratulate our contemporary on reaching the seventy-fifth year of its issue and would express the hope that it may continue to hold for many years to come the high place in technical journalism which it now commands.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/- to 19/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 15 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 6 0	—
„ „ Foundry	3 11 0	—
(c) Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (a) / 4 5 6 (b) / 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 5 0	8 5 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 2 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 7 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 12 6 and 9 2 6	—
Intermediate Basic	7 2 6 and 7 12 6	—
Soft Basic	6 5 0	—
Hoops	10 5 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 5 0	—
Billets and Sheet Bars	5 12 6 to 6 10 0	—
Galv. Sheets, f.o.b. L'pool	11 5 0	—
(2) Staffordshire Hoops	9 10 0	—
Angles	— *	—
Joists	— *	—
Tees	— *	—
Bridge and Tank Plates	— *	—
Boiler Plates	9 7 6 to 9 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/3 to 15/6
Block Tin (cash)	113 12 6
„ (three months)	115 0 0
Copper (cash)	44 15 0
„ (three months)	44 10 0
Spanish Lead (cash)	14 6 3
„ „ (three months)	14 7 6
Spelter (cash)	13 0 0
„ (three months)	13 7 6
MANCHESTER—	
Copper, Best Selected Ingots	47 0 0
„ Electrolytic	47 15 0
„ Strong Sheets	77 0 0
„ Tubes (Basis Price), lb.	0 0 11½
BrassTubes (Basis Price), lb.	0 0 10
„ Condenser, lb.	0 1 0½
Lead English	15 12 6
„ Foreign	14 5 0
Spelter	13 2 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 5 6	7/-
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£33 0 0	10/-
„ „ „ 1 p.c. carbon	£38 0 0	13/-
„ „ „ 0·70 p.c. carbon	£41 0 0	14/-
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
„ „ „	£11 5 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	10d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	15/6
„ „ Splint	16/- to 17/-
„ „ Trebles	14/6
„ „ Doubles	14/-
„ „ Singles	14/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/-
„ „ Jewel	18/-
„ „ Trebles	14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 14/-
Screened Navigation	16/6 to 17/6
Trebles	14/6 to 16/6
Doubles	13/-
Singles	12/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6
Secondary Steam	13/6
Trebles	15/-
Doubles	13/9 to 14/-
Singles	12/6 to 13/-

ENGLAND.

(8) N.W. COAST—	
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 21/-
NORTHUMBERLAND—	
Best Steams	13/6 to 13/9
Second Steams	12/6
Steam Smalls	10/- to 10/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	15/- to 15/6
Second	13/9 to 14/-
Household	25/- to 37/-
Foundry Coke	26/- to 28/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	25/6 to 27/-	—
Derbyshire Best Bright House	20/- to 22/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	18/- to 19/-	—
„ „ Nuts	15/6 to 16/6	—
Yorkshire Hards	14/- to 15/6	—
Derbyshire Hards	14/- to 15/6	—
Rough Slacks	8/6 to 9/-	—
Nutty Slacks	6/6 to 7/-	—
Smalls	3/- to 5/-	—
Blast-furnace Coke (Inland)	11/- on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.	15/6 to 16/-	

(9) SOUTH WALES.

CARDIFF— * *No reliable prices can be quoted.*

Steam Coals :	
Best Smokeless Large	—
Second Smokeless Large	—
Best Dry Large	—
Ordinary Dry Large	—
Best Black Vein Large	—
Western Valley Large	—
Best Eastern Valley Large	—
Ordinary Eastern Valley Large	—
Best Steam Smalls	—
Ordinary Smalls	—
Washed Nuts	—
No. 3 Rhondda Large	—
„ „ Smalls	—
No. 2 „ Large	—
„ „ Through	—
„ „ Smalls	—
Foundry Coke (Export)	—
Furnace Coke (Export)	—
Patent Fuel	21/6
Pitwood (ex ship)	23/- to 23/6

SWANSEA— * *No reliable prices can be quoted.*

Anthracite Coals :	
Best Big Vein Large	—
Seconds	—
Red Vein	—
Machine-made Cobbles	—
Nuts	—
Beans	—
Peas	—
Breaker Duff	—
Rubbly Culm	—
Steam Coals :	
Large	—
Seconds	—
Smalls	—
Cargo Through	—

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. Delivered Black Country Stations.

* Prices of all South Wales coals are nominal, as standing stocks are almost exhausted. * Under Revision at time of going to Press.

French Engineering Notes.

(From our own Correspondent in Paris.)

National Equipment Scheme.

WHEN the supply of German plant and machinery on account of reparations practically ceased with the operation of the Young Plan, this country found itself seriously embarrassed through the holding up of public works which had been put in hand on the strength of the German participation. The Government decided to continue the programme with the aid of the national funds. The matter has been the subject of interminable debate, and is now at much the same stage as it was a year ago. Contractors are suffering serious losses, and it is feared that if the present state of things be allowed to continue there will be many claims for damages. The Union des Chambres de Commerce Maritimes et des Ports Français met recently to discuss the situation, when Monsieur Watier, Director of Navigable Waterways and Maritime Ports, recognised the seriousness of the situation, and said that the Minister of Public Works intended to ask Government to provide immediately 70 million francs for the ports, 20 millions for inland waterways, and 95 millions for roads, so that the various undertakings now in hand could be continued until such time as credits were voted to carry out the entire scheme.

Water Supply.

One of the most important undertakings under the scheme of national equipment is to supply the communes and villages throughout the country with pure water, and thereby avoid what is at present a standing menace to public health and a serious inconvenience in many regions which suffer from prolonged spells of water famine. Two years ago Parliament voted an annual expenditure of from 35 to 40 million francs upon an improvement in rural water supplies. To that sum were added subsidies and loans amounting, in two years, to a total of 715 million francs. It is feared that this work will be retarded now that Government proposes to reduce considerably the annual expenditure. Therefore, particular interest was attached to a communication which Monsieur Diénert made recently to the Institut de Technique Sanitaire, when he dealt with a new system of water sterilisation by means of what is called "metallised sand." This is a special filtering sand, which is said to absorb the sterilising element and to allow the water to pass through in a perfectly pure state without leaving any trace of the ingredient. It is claimed that one cubic metre of "metallised sand" will sterilise 100 cubic metres of water a day.

Motor Cars.

When the increasing imports of motor cars, particularly from the United States, threatened the home industry, which was already suffering from diminishing exports, the Government adopted a new method of levying import duties on cars, whereby they were increased all round to a very appreciable extent. That was eight months ago, and the returns of foreign trade during the first eleven months of last year show that this attempt to protect the home motor car industry has not been effective. Compared with the similar period of 1929, the number of cars exported declined from 45,008 to 28,728, and the value fell from 1436 million francs to 890 million francs. The number of cars imported during the first eleven months of last year was 7560, as compared with 8902 in the similar period of 1929, while the number of cars erected in France with imported parts was estimated to be 14,000 in the first eleven months of last year and 12,800 in the corresponding period of 1929. The total value last year was 286 million francs as against 277 million francs. There was consequently a decline of 38 per cent. in exports and an increase of about 3 per cent. in imports, this being due mainly to the erection of Ford cars with imported parts and to the importation of Italian cars, the number of which increased after the augmented tariff. This state of things is being made use of to suggest the necessity of protecting still further the home motor car industry.

Permanent Way Maintenance.

The removal of weeds from the permanent way was always done by hand until the Nord Railway employed experimentally a mechanical plant for the purpose. Of late, some of the railway companies have been giving attention to the chemical destruction of weeds by methods that have proved quite successful in agriculture, where a dilute solution of sulphuric acid is generally used, but as there can be no question of spraying this acid on the permanent way, the P.L.M. Company experimented with various safe solutions, until it decided upon chlorate of soda in the proportion of 250 kilos. of chlorate to about 1 cubic metre of water. This is found to destroy the weeds without having a corrosive effect upon the rails. Trucks carrying the tanks are coupled to a goods train, and, while travelling at something like 35 miles an hour, a motor pump in a closed van sprays the solution through jets behind. It is stated that 46 tons of solution will destroy completely any ordinary growth of weeds over 67 miles of track. The cost is much less than that of any mechanical method yet employed.

The Coal Situation.

The result of the British miners' strike in 1926 was to increase permanently the continental coal production by 30,000,000 tons a year, that being the amount equal to the then British exports. It marked the beginning of a competition for the foreign coal trade which has since then never slackened. Any prolonged stoppage of coal production in Great Britain at the present moment must introduce further permanent influences detrimental to British trade. There is no market now in which British coalowners can claim a monopoly. They enjoy the advantages of supplying qualities of coal which are preferred by certain classes of foreign consumers, who, however, will not pay higher prices when they are offered foreign coal sufficiently good at much lower cost, and for the first time foreign coal producers are able to supply any deficiency, even in Great Britain.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

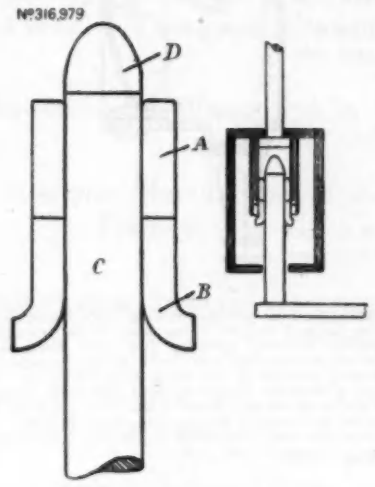
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

316,979. August 6th, 1929.—OIL SWITCHES, *International General Electric Company Incorporated, of 120, Broadway, New York, United States of America.*

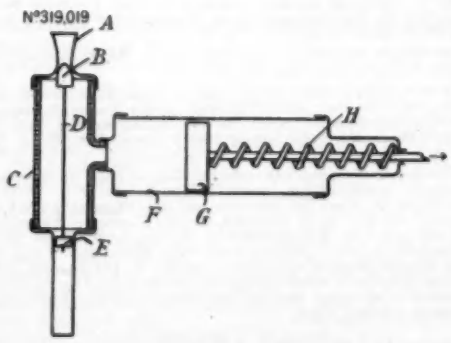
This invention relates to oil switches. If such a switch is closed on a heavy short circuit, then the contacts become heated to a high degree and may become welded together. Hence, in order to avoid such welding, the contacts are usually made large so as to increase their heat capacity. Where the switch is provided with extinguishing chambers, however, it is difficult to make the contacts sufficiently large owing to the restrictions imposed by the chambers, and it is the object of



this invention to provide means whereby this difficulty can be overcome. The stationary contact consists of two parts A and B, and the movable contact C has an extension D at the end. When the switch is closed, the parts B and D first come into contact and, therefore, have to carry the entire short-circuit current which initially is at its highest value. These parts B and D, therefore, consist of a silver-copper alloy. The parts A and C are less exposed to damage and in the usual manner may consist of copper or other suitable material. The arrangement of the contacts in the extinguishing chamber is shown in the right-hand illustration.—*December 8th*, 1930.

319,019. September 14th, 1929.—PNEUMATIC BLOW-OUTS FOR ELECTRIC SWITCHES, *International General Electric Company Incorporated, of 120, Broadway, New York, United States of America.*

This invention relates to pneumatic blow-outs for electric switches of the kind in which the arc between the separating contacts is extinguished by a jet of air blown across the path of the arc. The contacts A, B are connected with the supply lines. The movable contact B is drawn into a casing C of insulating material by means of a rod D and a piston E. The casing is connected with a cylinder F in which a piston G, under the influence of a spring H acting as an energy accumulator, tends to move towards the left. By means of a device, not shown, the piston is moved—electrically, hydraulically

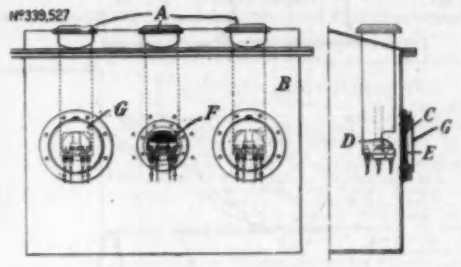


or by hand—in the direction of the arrow and the spring H is thereby compressed. By means of a valve, which is closed automatically when the piston moves back, the cylinder is filled with air. In the end position the piston is held firmly by a pawl. Since any length of time is available for tensioning the spring, a small force through a large transmission ratio can be used. If switching off is desired, the pawl is released, the piston G then suddenly drives the air in front of it into the switch and the air presses on the piston E and moves the contact B downwards, whilst the greater part of the air moved is expelled between the contacts. The contents of the cylinder and the spring tension, that is to say, the volume of air and the pressure, are adjusted according to the rupturing capacity of the switch.—*December 11th*, 1930.

TRANSFORMERS AND CONVERTERS.

330,527. January 11th, 1930.—ELECTRIC TRANSFORMERS, Ferranti Ltd., of Hollinwood, Manchester, and John Turner, of the same address.

The invention consists in the provision of an inspection window in the casing of a transformer to enable inspection of the transformer or associated mechanism to be made without removing the transformer or mechanism from the casing. The invention is shown as applied to an oil-immersed electric transformer with tap-changing mechanism within tubular members A depending within the casing B. Apertures C are arranged adjacent to the contacts D of the tap-changing mechanism. Each orifice is covered by a window E, formed by a plate of unsplinterable glass, the plate being firmly pressed against the casing by the aid of oil-tight gaskets and a clamping ring secured by studs and nuts. A wire mesh earthing screen



F is provided either inside or outside the inspection window for the protection of the observer and also to prevent distortion of the electric field. In addition, there is a metal cover G, which is clamped in similar fashion to the casing in register with each window, this cover serving to protect the window from injury and also, if necessary, to prevent leakage of oil, should any inadvertent leakage take place through the window pane gaskets or through the window pane itself in case of fracture. It will be understood that, in accordance with the invention, the working of the contacts may be inspected while the transformer is in operation.—*December 11th*, 1930.

ELECTRICAL APPLIANCES.

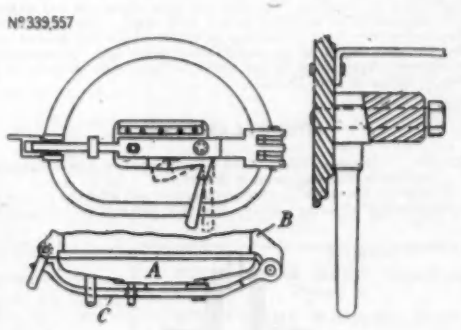
330,451. November 14th, 1929.—ELECTRON-EMITTING CATHODES FOR ELECTRIC DISCHARGE DEVICES, The Gramophone Company, Ltd., of Hayes, Middlesex, and Geoffrey Bernard Baker, of 16, Crick-road, Oxford.

This invention relates to electron-emitting cathodes for electric discharge devices and more particularly to a method for their preparation. In the method of preparing a cathode according to the invention a base, such, for example, as a refractory core or a so-called oxide-coated filament, is coated with a substance which, on heating in the absence of appreciable oxygen, leaves a residue containing the oxide of an electron-emitting metal and free carbon. Suitable substances for this purpose are the tartrates of the alkali or alkaline earth metals, for example, cæsium tartrate and barium tartrate. The refractory core may consist of tungsten, platinum, or nickel, or its alloys, whilst the oxide-coated filament may consist of a core of refractory material coated with barium oxide, which may contain free barium. In carrying out the invention the procedure is as follows. An oxide-coated filament or a filament of refractory material is dipped into or drawn through a paste containing barium tartrate. If a refractory filament without any oxide coating is used, a paste containing barium carbonate in addition to barium tartrate is preferably employed. The filament, after being coated in this manner, is heated to a temperature of between 800 deg. and 1000 deg. Cent., in an atmosphere of carbon dioxide and the barium tartrate coating thus converted into barium oxide and free carbon. The barium oxide combines with the carbon dioxide present to form barium carbonate, and a filament having a coating of barium carbonate and free carbon is obtained. The filament may then be mounted in a valve and the whole subjected to the usual treatment. It is not fully understood whether metals which are known as electron-emitting metals are always, in themselves, capable of intense electron emission or whether it is some compound thereof. The term electron-emitting metal, in this specification, is, therefore, intended to refer either to a metal which itself is capable of emitting electrons or to a metal capable of forming compounds which emit electrons.—*December 11th*, 1930.

GAS PRODUCERS.

339,557. February 19th, 1930.—DOORS OF GAS-MAKING RETORTS, R. and J. Dempster, Ltd., Manchester, and C. E. Holt, Oakles, Hill Top, Manchester-road, Wilmslow, Cheshire.

This invention is concerned with the closing of the doors of gas retorts, so that they may be as nearly as possible gas-tight.



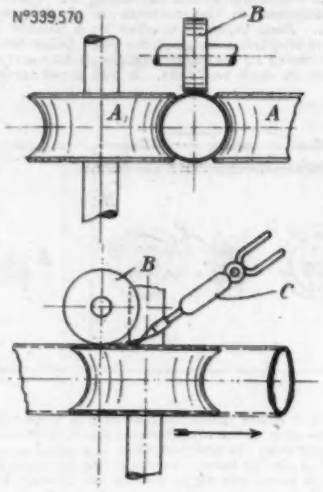
The door is shown at A and the end of the retort at B. The door is closed by means of a bar C, which is, essentially, carried by a multiple hinge, as shown, for the purpose of making a steady support. The tightening of the door against its seating is effected by the cam action of the lever, between the bar C and the door A, as shown in the enlarged drawing.—*December 11th*, 1930.

MACHINE TOOLS AND SHOP APPLIANCES.

330,570. March 10th, 1930.—WELDING METAL PIPES, H. Maywog, 82, Freibergerstrasse, Holzwickede, Westphalia, Germany.

According to this invention, butt-welded pipes are made by a combination of electric resistance welding and oxy-acetylene blow-pipe welding. The tube is passed between two grooved rolls, A A, which act as electrodes of similar polarity. Another roller B serves for the opposite pole of the circuit. It will be noticed that the centres of the rolls are set slightly in advance of one another. The electric current heats the edges to be welded

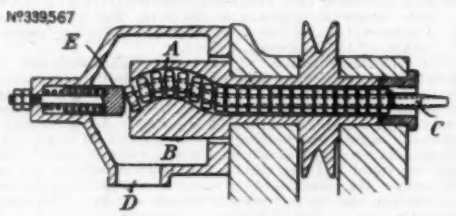
to incandescence and then the welding is completed by the blow-pipe C. There is no reference in the specification to the addition of extra metal to complete the weld. It is claimed that



pipes welded by these means can be produced at the rate of from 12 m. to 15 m. per minute.—*December 11th*, 1930.

339,567. March 1st, 1930.—NUT TAPPING MACHINES, H. Hahn, O. Hahn and K. Tessky, Esslingen a/N., Germany.

This machine is for screw-threading nuts as a continuous process. The threading tap is cranked at A, within a correspondingly curved passage in a spinner B, so that the tap is

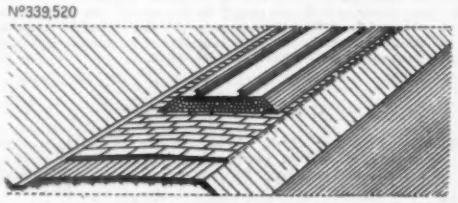


positively driven. The blank nuts are fed in at C and are forced forward by the screw thread to drop out at D. There is a spring control E at the outlet, which may take several forms other than that illustrated, to prevent the premature discharge of the screwed nuts.—*December 11th*, 1930.

TRAMWAYS AND RAILWAYS.

339,520. December 30th, 1929.—RAILWAY EMBANKMENTS, The Trinidad Deutsche Oel-und Asphalt-Aktiengesellschaft 16, Dresden-A., Germany, and A. Woerner, Von der Tannstrasse 29, Munich, Germany.

The inventors propose to obviate the trouble of railway sleepers pounding the permanent way into a muddy mass,

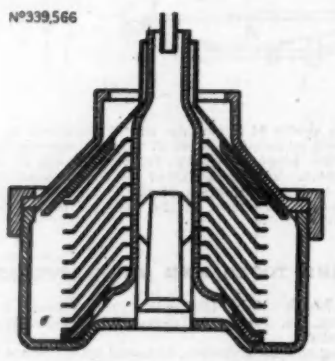


incapable of carrying the necessary loads, by making the subsoil impervious to moisture. To this end they cover the top of the embankment with bitumen mixed with sand. The coating is supplied in the form of bricks, or slabs, which are heated on the site, and rolled, or stamped, after being laid. Above this waterproof layer there is the usual ballast, with sleepers and rails.—*December 11th*, 1930.

MISCELLANEOUS.

339,566. February 28th, 1930.—CENTRIFUGES, Aktiebolaget Separator, Fleminggatan 8, Stockholm.

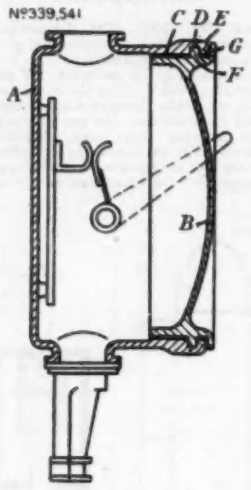
This invention would appear to be concerned with the cleaning of lubricating oil after service, but this point is by no means



clear in the specification. The apparatus is of the centrifugal type, and the principal aim is to ensure the continuous discharge of any sludge which may be separated from the oil. To this end a certain proportion of mercury is fed into the centrifuge, along with the oil. It provides, presumably, a liquid lining to the bowl, over which the sludge can be readily moved towards the outlet. It is suggested that in some stubborn cases yet another liquid may be fed into the centrifuge, with the object of washing away the sludge continuously.—*December 11th*, 1930.

339,541. January 30th, 1930.—CASINGS FOR ELECTRICAL APPARATUS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This specification describes a flame-proof casing for electrical apparatus in which the cover and the casing have discontinuous flanges to form a bayonet-joint, characterised in that a packing space is provided in a spigot and socket joint constituted by the wall of the casing and an annular projection on the cover. Into the casing A the cover B is inserted, with an annular projection C spaced away from the inner wall of the casing, which is provided with a groove D, thus forming a casing flange E.



The cover possesses an inner flange F, engaging with the groove of the casing, and an overlap G resting on the casing flange E. The cover flange F and the casing flange E are provided with corresponding cut-away portions. The cover, when inserted, brings the flange portions E of the cover into correspondence with the cut-away portions of the casing flange. The cover is then turned in a clockwise direction, until the cover flanges are behind the casing flanges. Between the packing surfaces proper and between the overlap G and the casing flange E, distance strips are arranged at certain intervals to ensure a predetermined small gap.—*December 11th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—At Armstrong College. "Transformers," by Mr. W. T. Tracey. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London. Informal meeting. Discussion on "Steam *versus* Oil Engine in the Mercantile Marine," introduced by Major William Gregson. 7 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—In the Building of the Manchester Literary and Philosophical Society, 36, George-street, Manchester. "Locomotive Suspension and its Influence on Derailments," by Mr. T. H. Sanders. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Some Problems Surrounding the Reorganisation of an Engineering Works," by Mr. K. W. Willans. 7.30 p.m.

NATIONAL CONFERENCE ON INDUSTRIAL MECHANISATION.—Hotel Metropole, London, W.C. 2.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre of the Mining Institute, Newcastle-on-Tyne. "Some Factors Influencing the Sizes of Crank Shafts for Double-acting Diesel Engines," by Mr. S. F. Dorey. 6 p.m.

PHYSICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "The Influence of Low Temperatures on the Thermal Diffusion Effect," by Mr. T. L. Ibbs and Mr. K. E. Grew; "Further Experiments on Magnetostriction Oscillators at Radio Frequencies," by Dr. J. H. Vincent; "The Equivalent Circuit of the Magnetostriction Oscillator," by Mr. S. Butterworth and Mr. F. D. Smith; "The Theory of the Microscope," by Dr. L. C. Martin. 4.45 p.m. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.

SATURDAY, JANUARY 17TH.

HULL ASSOCIATION OF ENGINEERS.—In the Municipal Technical College, Hull. "Air Compressors," by Mr. R. L. Quertier. 7.15 p.m.

MONDAY, JANUARY 19TH.

BRADFORD ENGINEERING SOCIETY.—Bradford Technical College. "The Operation of Belt Drives," illustrated by lantern slides, by Dr. H. W. Swift. 7.30 p.m.

TUESDAY, JANUARY 20TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, London, W. 1. "The Art of Illumination," by Mr. J. W. T. Walsh. 5.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—Sheffield Metallurgical Club, 198, West-street, Sheffield. "The Practical Applications of X-ray Analysis to Metals," by Dr. G. Shearer. 7.30 p.m.

TUESDAY AND WEDNESDAY, JANUARY 20TH AND 21ST.

SOCIETY OF GLASS TECHNOLOGY.—Tuesday, 7 p.m., County Hotel, Newcastle-upon-Tyne, informal dinner; 8.15 p.m., Furnace Committee meeting, County Hotel. Wednesday, 9.30 a.m., visit to Lemington Glass Works; 10 a.m., Council meeting at the Lemington Glass Works; 12.30 p.m., luncheon, County Hotel, Newcastle-upon-Tyne. In the County Hotel, Newcastle-upon-Tyne. "Industrial Research from the Business Aspect," by Mr. Christopher Wilson. 2.15 p.m.

WEDNESDAY, JANUARY 21ST.

INSTITUTION OF ENGINEERING INSPECTION.—At the Rooms of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "The Metal-clad Principle for Electrical Switchgear," illustrated, by Mr. John R. Cowie. 5.30 p.m.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE.—Houghton-street, Aldwych, W.C. 2. "Muscular Work and Fatigue," by Dr. G. P. Crowden. 6 p.m.

NEWCOMEN SOCIETY.—At Caxton Hall, Westminster (Room 13), S.W. 1. "The South Staffordshire and North Worcestershire Mining District and its Relics of Mining Appliances," by Mr. T. E. Lones. 5.30 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington. At 7.30 p.m., ordinary meeting for the election of new Fellows; at 7.40 p.m., annual general meeting. Presentation of the Buchan Prize to Mr. C. E. P. Brooks. "The Scientific Work of the Meteorological Office, Cardington," by Mr. R. G. K. Lempfert.

ROYAL MICROSCOPICAL SOCIETY.—B.M.A. House, Tavistock-square, London, W.C. 1. Annual meeting. Professor R. Ruggles Gates will deliver his presidential address. 5.30 p.m.

THURSDAY, JANUARY 22ND.

INSTITUTE OF MARINE ENGINEERS: JUNIOR SECTION.—In the Lecture Hall of the Institute, The Minories, E.C. 3 (*viâ* Mark-lane or Aldgate Station). A lecture and film display, "The Progress and Development of Steam Generators," by Mr. E. W. Thompson (director, John Thompson Water Tube Boilers, Ltd.); "The Weybridge Works of Vickers (Aviation), Ltd., 1929;" "Happy Days Afloat," illustrating river and sea trips in Thornycroft cabin cruisers and speed boats. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "High-voltage Testing Equipments," by Messrs. E. T. Norris and F. W. Taylor; and "Dielectric Phenomena at High Voltages," by Messrs. B. L. Goodlet, F. S. Edwards, and F. R. Perry. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Deck Flying," by Squadron Leader W. R. D. Acland. 6.30 p.m.

FRIDAY, JANUARY 23RD.

INSTITUTE OF FUEL.—At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. The Melchett Medal for 1930 will be presented to Dr. Kurt Rümmel, who will deliver the Melchett Lecture, his subject being "The Calculation of the Thermal Characteristics of Regenerators." 6.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. 1. "High-pressure Locomotives," by Mr. H. N. Gresley. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "The Progress and Development of Steam Generators," by Mr. E. W. Thompson. (Illustrated by slides and a film). 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, London, W. 1. Discourse, "The Scattering of Light," by Sir William Bragg. 9 p.m.

MONDAY, JANUARY 26TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. 1. Graduates' Section. "Windmills and Millwrighting," by Mr. R. Wailes. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture: "Some Modern Developments in Microscopy," by Dr. L. C. Martin. 8 p.m.

TUESDAY, JANUARY 27TH.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "The Selection of Suitable Steels for Gears," covering the various requirements of steels for gear manufacture, the most suitable compositions of steel for case hardening, and the effect of compositions and structure on the subsequent treatment, and the results in service, by Mr. Francis W. Rowe. 7.30 p.m.

WEDNESDAY, JANUARY 28TH.

ASSOCIATION OF EX-SIEMENS' MEN.—At Gatti's Restaurant, King William-street, Strand, W.C. 2. Smoking concert.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE.—Houghton-street, Aldwych, W.C. 2. "Muscular Work and Fatigue," by Dr. G. P. Crowden. 6 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London W.C. 2. "The Restoration of St. George's Chapel, Windsor Castle," by The Very Rev. Albert Baillie, Dean of Windsor. 8.30 p.m.

THURSDAY, JANUARY 29TH.

DIESEL ENGINE USERS ASSOCIATION.—307, Abbey House, Westminster, S.W. 1. Report of the Committee of the Association on Heavy Oil Engine Working Costs, 1928–29. 3 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Annual dinner of the Association in the Great Northern Station Hotel, Leeds. Reception, 6.30 p.m.; dinner, 7 p.m.

ROYAL AERONAUTICAL SOCIETY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Development and Construction of Sailplanes and Gliders," by Herr A. Lippisch. 6.30 p.m.

FRIDAY, JANUARY 30TH.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—At Lyons' Corner House, Angel, Islington, N. 1. Annual dinner and dance.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Modern Methods of Production of Small Machined Work," by Mr. Wilfrid Fish. 7.30 p.m.

WEDNESDAY, FEBRUARY 4TH.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE.—Houghton-street, Aldwych, W.C. 2. "Muscular Work and Fatigue," by Dr. G. P. Crowden. 6 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Effect of Standardisation on Engineering Progress," by Mr. C. le Maistre. 8 p.m.

FRIDAY, FEBRUARY 6TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Aerial Wire Ropeways," by Mr. J. W. White. Slides. 7.30 p.m.

THURSDAY, FEBRUARY 12TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—At the Connaught Rooms, Great Queen-street, W.C. Annual dinner and reunion. Reception 7 p.m., dinner 7.30 p.m.